FINAL REPORT

FORT GORDON ENERGY SURVEY & ANALYSIS OF BOILER AND CHILLER PLANTS

BUILDING 25910
BUILDING 25330

PROPOSED ENERGY CONSERVATION OPPORTUNITIES
FOR
SAVANNAH DISTRICT CORPS OF ENGINEERS
CONTRACT NUMBER: DACA21-93-C-0110

VOLUME I
OF 3

3 APRIL 1995

HARRISON AND SPENCER, INC.
ENGINEERS • ARCHITECTS • PLANNERS
438 COTTON AVENUE
P.O. BOX 4246
MACON, GEORGIA
(912) 742-5751

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
CHAMPAIGN, ILLINOIS 61826-9005

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VOLUME I

PROJECT NO. 1

CHILLED WATER NORTH

BUILDING 25910

GENERAL PROJECT NO. 1

GENERAL DESCRIPTION:

Project No. 1 is all of the recommended ECO's combined for the chilled water system in the North area, which is controlled and supplied from Building 25910. The attached project drawing shows an upgrade and general layout of equipment, showing the reuse of the existing cooling towers with new piping from them which will go through a free cooling heat exchanger. There will be pumps at each chiller that will extract the required amount of cooling water through a loop piping arrangement. Chillers 5, 6, and 7are existing, but new higher efficiency chillers will be added in the size range of one 400 ton and two of 1,250 ton chillers.

Return chilled water will either be run in a loop that will feed any of the chillers which have its new pump "on" to circulate the chilled water through it, or if no pumps are "on", the water will circulate through the new free cooling plate heat exchanger to be located in Building 25910. Teed off of the return chilled water system there will be a pipe that feeds a chilled water storage tank which will be located behind the Plant in the woods. There will be a pump parallel with that line so that if additional pressure is needed to get the water up to the top of the storage tank, that pump will come on. The water in that pipe and water in the pipe leaving at the bottom of the chilled water storage will go back to the Plant. Both of these pipes will have flow in either direction, depending on whether the storage tank is being charged as it will be at night in the summer time, or whether it is being discharged during the peak cooling hours during the day in the summer.

The existing chilled water distribution pumps will remain in operation, but the drives will now be controlled by a single variable speed drive. There will be one variable speed drive for each set of duplicate pumps so that whether one pump or the other back-up pump is running, the variable speed drive will be switched so that it can be controlled to maintain a flow necessary to get buildings the required amount of chilled water. This will be monitored and controlled by the EMCS system.

HOW TO OBTAIN MAXIMUM EFFICIENCY:

Controls and instrumentation added to the EMCS system will allow 24-hour observation of the system and monitoring of equipment operation, temperatures, pressures, flows, amps, etc., to ensure the maximum efficiency is obtained. It will also be the function of the EMCS monitors to compile information so that variations in condenser water flow and chilled water pumping speeds can be monitored, dated, and recorded so that the maximum efficiencies can be obtained and passed onto the next shift for future operations.

The free cooling system will operate primarily in the winter time, and will use cooling towers only to obtain chilled water to be stored at 42°F. This can happen during the night in the winter time. When this happens, not only will the chilled water be circulated to the system as required, which is a year-round requirement, but it can also be stored in the storage tank for use during the day when the temperature rises above the outside ambient temperature not allowing the free cooling system to operate.

Chilled water storage system will operate so that in the low demand times, chilled water can be generated with the chillers and not affect the electrical demand at Fort Gordon. That chilled water will be stored in a 1 million + gallon chilled water storage tank. This stored chilled water can be used during the peak hours in the day to maintain the demand at its lowest possible level. Again, EMCS data will be important in determining when to use the chilled water storage and when to generate chilled water, and how it will affect the overall demand of electricity at Fort Gordon.

COMPILATION OF DATA:

Because all of the ECO's listed under Project No. 1 for the chilled water on the North loop, the cost will be added and an overall simple payback will be determined on the following page.

Simple Payback No.	5.16
SIR for Composite Project	3.02

LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: PROJ001
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 1 CHILLED WATER NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: COMPOSITE
ANALYSIS DATE: 02-19-95 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 2320252.		
B. SIOH	$ 127614.		
C. DESIGN COST	$ 139215.		
D. TOTAL COST (1A+1B+1C)	$ 2587081.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 2587081.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	18713.	$ 285112.	15.61	$ 4450594.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 179970.	14.74	$ 2652758.
N. TOTAL		12719.	$ 465082.		$ 7103352.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 3515.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 51811.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. TOTAL	$ 657760.	0	1.00	657760.
d. TOTAL	$ 657760.			657760.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 709571.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 501485.

5. SIMPLE PAYBACK PERIOD (1G/4) 5.16 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 7812923.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 3.02
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 8.96 %

PROJECT NO. 1 - CHILLED WATER NORTH

ECO DATA COMPILATION

ECO NO.	DESCRIPTION	CONSTRUCTION COST	ANNUAL RECURRING COST	NON-RECURRING COST (-) SAVINGS (+)	COST (From LCC)	ELECTRICAL SAVINGS MMBTU/YR	DEMAND SAVINGS $	SAVINGS 1st YEAR	TOTAL DISCOUNT SAVINGS
6	Chem Treatment-CHW	13,910.40	-4,000	630,000	15,510	0	0	27,500	571,040
23	Variable Speed CHW Pumping	394,703.82	-2,000	0	440,096	5,728.48	0	85,278	1,332,935
29	Temp Reset	27,972.00	0	0	31,190	451.655	0	6,881	107,418
33	Reduce Make-Up Water	33,566.40	5,015	0	37,427	162.015	0	7,483	112,453
43	Cooling Tower Manifolding	130,183.20	0	22,000	145,154	376.38	0	6,834	111,515
47	Cooling Tower Water Treatment	1,765.26	2,500	5,760	1,968	376.38	0	8,522	132,125
51	Free Cooling	89,775.00	0	0	100,100	2,655.64	0	40,461	631,596
53	CHW Storage	592,118.86	0	0	660,214	0	179,970	179,970	2,652,763
85	Replace Chillers	974,862.00	2,000	0	1,086,972	7,884.48	0	122,127	1,904,660
86	EMCS Controls & Instrumentation	61,394.76	0	0	68,456	1,078.17	0	16,427	256,423
	Totals	2,320,251.70	3,515	657,760	2,587,087	18,713.20	179,970	501,483	7,812,928

Simple Payback: $\frac{2,587,087}{501,483} = 5.16$

SIR: $\frac{7,812,928}{2,587,087} = 3.02$

ECO METHODOLOGY FORM

ECO NAME:	Treatment of Make-up Water to Chilled Water System
ECO NUMBER:	6
TYPE: BLDG SYSTEM:	Bldg. 25910 Cooling
EXISTING CONDITIONS:	The existing chemical treatment systems serve the condenser side of the chilled water system and are feeding a C-6220 chemical from Industrial Maintenance Corporation into the condenser water system and also adding an A-102 microbiocide by the bucket as the algae begins to build up in the cooling towers. There is no chemical feed on the chilled water side of the system. There is a large volume of make-up water to the chilled water side, which is taken off the fire hose, and is not treated at this time. There isn't any way to treat the make-up water to the chilled water system with the present equipment.
PROPOSED CHANGE:	The proposed system would be to install a coupon system where there are coupon materials located within the contact of the chilled water system to determine what chemicals need to be added to the chilled water system to keep the various coupon materials that may come into contact with the chilled water from corroding. The coupon system is not necessary on the condenser water side because there is actually conductivity meters that are measuring the water on that side, and there is a very limited amount of piping from the cooling towers to the chillers.
CALCULATION & COST METHODOLOGY:	The savings would be the longer life of the chilled water piping system and would be offset by the increased cost in chemicals and installation of the coupons.

Installation of coupon Materials	$2,000	Labor	$2,000
Chemical feed system Materials	$3,500	Labor	$2,500

Because chemicals are now being added, the increased cost of chemicals will be $4,000 per year. All of these costs will be offset by the savings of the life of the chilled water system. Chilled water system piping is $9,000,000 cost and the life will be 25 years instead of 20 years with chemical treatment. This is computed as a 20-year life with treatment and a 16-year life without chemical treatment. The cost of the chilled water piping system is estimated by scaling the chilled water distribution drawing and multiplying the cost of average pipe sizes by the scaled lengths of that size or nearby sizes.

CONSTRUCTION COST ESTIMATE	DATE: 23 SEPT 94	SHEET 1 OF 1

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA — **PROJ. NO.**

Arch/Engr: HARRISON AND SPENCER, INC. — **CODE:** BLDG 25910

Summary: ECO #6 - TREAT MAKE-UP WATER — **Estimator:** H. TOUB — **Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
CHEMICAL FEED SYSTEM	1	LS	3500	3500	2500	2500	$6,000.00
TEST COUPON	1	LS	2000	2000	2000	2000	$4,000.00
	SUBTOTAL			5500		4500	
	5% SALES TAX			$275.00			
	17% LABOR TAX					$765.00	
	SUBTOTALS			$5,775.00		$5,265.00	$11,040.00
	20% OH (GC ONLY)						$2,208.00
	SUBTOTAL GC'S WORK						$13,248.00
	SUBTOTAL(GC & SUBS)						$13,248.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$662.40
	TOTAL						**$13,910.40**

ECO METHODOLOGY FORM

ECO NAME:	Variable Speed Chilled Water Pumping
ECO NUMBER:	23
TYPE: BLDG SYSTEM:	Bldg. 25910 Cooling
EXISTING CONDITIONS:	There are two zones and each zone is served by a set of identical pumps, one backing up the other. Existing pumps all have single speed motors. Buildings on the distribution system, in most cases, have pumps to override the increased pressure drop through the building. 3- way valves are at all of the air handling units and fan coil units in the building.
PROPOSED CHANGE:	The existing pumps shall remain in place, but new variable speed drives should be added to the existing motors in this building. In each building in the chilled water distribution system on the north and the 3-way valves at each of the air handling unit coils will be modified so that the bypass line will be capped off on both directions. (See sketch on following page.) In effect, the 3-way valve will operate as if it were a 2-way valve and reduce flow when chilled water is not required by the coil. The chilled water pump in the building will be operated by the EMCS system so that it will only operate during scheduled chilled water requirements, and will be shut off during times then the building is not in need of cooling. Controls that are tied to the EMCS system will have to be added so that when all the coils shut down for some length of time and when the time is exceeded, the chilled water pump in the building also shuts down. There should also be a time delay so that the pump starts again when enough 3-way valves open to require the chilled water pump to be on. It is expected, in some cases even with the chilled water pump off, there will be sufficient flow in the buildings that are close to the 25910 plant so that the chilled water pump may not be necessary. Because there is no savings on ECO 21 for the primary/ secondary chilled water loop, the cost of the secondary pumps and piping will be included in this ECO.

CALCULATION & COST METHODOLOGY

The cost estimate is as follows:

Six secondary pumps required for the primary/secondary loop:

Materials	$48,000	Labor	$ 6,000

20-inch piping as shown on Project No. 1 drawing:

Materials	$10,000	Labor	$20,000

Building controls and EMCS instrumentation for 96 buildings

Materials	$36,000	Labor	$30,000

One variable speed 200 horsepower drive

Material	$17,500	Labor	$ 1,000

One set of switches (2) at $4,340

Materials	$ 8,680	Labor	$ 3,000

Piping changes within all the buildings in the distribution system

Materials	$28,800	Labor	$19,200

Controls and instrumentation in the plant

Materials	$ 5,000	Labor	$ 2,000

Electrical work

Materials	$ 2,000	Labor	$10,000

One 300 horsepower variable speed drive

Materials	$28,400	Labor	$ 1,000

ECO METHODOLOGY FORM

ECO NAME:	Variable Speed Chilled Water Pumping (Cont'd)
ECO NUMBER:	23
TYPE: BLDG	Bldg. 25910
SYSTEM:	Cooling
CALCULATION & COST METHODOLOGY:	

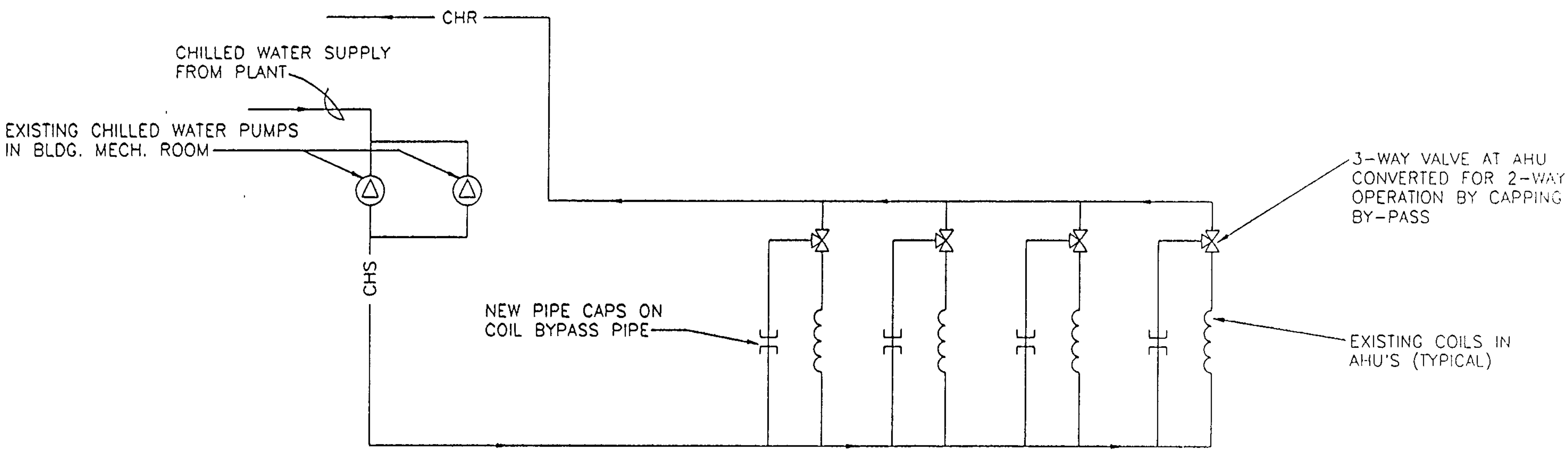
One set of two switches at $4,340 each

Materials $ 8,680 Labor $ 3,000

Savings will be the amount saved by having variable speed drives versus constant speed drives for the primary chilled water pumps. The enclosed Bell & Gossett program has been run to show the difference in cost between constant speed and variable speed for the same pumps. Variable speed pumping is obtained by taking the full capacity of the plant as computed and breaking it down into 10% increments of that capacity and then determining the number of hours per bin, and the number of hours on a representative day. From this, the flow can be determined at each speed to come up with the total number of hours that generate flows in the 10% capacity bins allocated. The amount of pumping by each set of pumps is determined based on the pump curves that were available. When this ECO is designed, it would advisable that the designer recheck the actual requirements or demands on the system for each building and the total flow requirements to see that it matches the pump size selected. This will be a confirmation of the existing system. The savings from Pumps 1 and 2 is 434,231.3 KWH and Pumps 3 and 4 is 1,244,198.6 KWH for a total of 1,678,429.9 KWH savings per year. This equates to $\frac{1,678,429.9}{10^6} \times 3413 = 5728.48$ Million Btu's/year

CONSTRUCTION COST ESTIMATE		DATE: 23 SEPT 94	SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY			
Location: AUGUSTA, GEORGIA		PROJ. NO.	
Arch/Engr: HARRISON AND SPENCER, INC.		CODE: BLDG 25910	
Summary: ECO #23 - VARAIBLE CHILLED WATER PUMPING	Estimator: H. TOUB	Checked:	

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
SECONDARY PUMPS	6	EA	8000	48000	1000	6000	$54,000.00
PIPING	1	LS	10000	10000	20000	20000	$30,000.00
CONTROLS & INSTRUMENTAION	1	LS	36000	36000	30000	30000	$66,000.00
VARIABLE SPEED DRIVE (200 HP)	1	LS	17500	17500	1000	1000	$18,500.00
SWITCHES	2	EA	4340	8680	1500	3000	$11,680.00
PIPING CHANGES	1	LS	28000	28000	19200	19200	$47,200.00
CONTROLS & INSTRUMENTATION IN PLANT	1	LS	5000	5000	2000	2000	$7,000.00
ELECTRICAL WORK	1	LS	2000	2000	10000	10000	$12,000.00
VARIABLE SPEED DRIVE (3OO HP)	1	LS	28400	28400	1000	1000	$29,400.00
SWITCHES	2	EA	4340	8680	1500	3000	$11,680.00
	SUBTOTAL			192260		95200	
	5% SALES TAX			$9,613.00			
	17% LABOR TAX					$16,184.00	
	SUBTOTALS			$201,873.00		$111,384.00	$313,257.00
	20% OH (GC ONLY)						$62,651.40
	SUBTOTAL GC'S WORK						$375,908.40
	SUBTOTAL(GC & SUBS)						$375,908.40
	10% GC'S PROFIT						
	5% CONTINGENCY						$18,795.42
	TOTAL						**$394,703.82**



OPTION #2: ADD VARIABLE SPEED DRIVE TO EXISTING BLDG. CHILLED WATER PUMPS SO THAT MAXIMUM PRESSURE IN CHILLED WATER SUPPLY LEAVING BLDG. PUMPS WILL NOT REACH DEAD-HEAD SETTING.

TYPICAL BLDG. CHILLED WATER MODIFICATION FOR VARIABLE SPEED PUMPING

B&G Pumping System Analysis:

SUMMARY OF INPUT DATA: 25910 COOLING Pumps 1+2

System peak demand: 2800.00 gpm
System discharge pressure: 164.00 ft. (71.04 psig)
Minimum control/Static pressure: 25.00 ft. (10.83 psig)

Standard Efficiency (SE) 60-cycle motor.

1 Pump System:

Pump 1: Series VSCS 10X12X13L, Impeller diameter 12.875"
Design RPM = 1770.0, Motor HP = 200.00

CONSTANT SPEED OPERATION:

Hrs	Q/Qd,%	TGPM	TDH,ft	BHP	Ep,%	BHP/HP,m	HP,in	E,mtr,%	kWHR	$/day	E,w/w,%
6.07	10.0	280.0	183.2	87.49	14.8	0.437	101.21	86.4	458.1	18.32	12.8
4.40	20.0	560.0	183.2	87.49	29.6	0.437	101.21	86.4	332.1	13.28	25.6
2.34	30.0	840.0	182.8	87.49	44.3	0.437	101.21	86.4	176.6	7.06	38.3
2.99	40.0	1120.0	182.2	95.59	53.9	0.478	105.48	90.6	235.2	9.41	48.8
2.51	50.0	1400.0	181.2	103.90	61.6	0.520	111.82	92.9	209.3	8.37	57.3
1.67	60.0	1680.0	179.7	112.11	68.0	0.561	120.59	93.0	150.2	6.01	63.2
1.17	70.0	1960.0	177.3	119.78	73.3	0.599	128.80	93.0	112.4	4.49	68.1
1.34	80.0	2240.0	174.1	127.00	77.5	0.635	136.51	93.0	136.4	5.46	72.1
0.92	90.0	2520.0	170.4	134.27	80.7	0.671	144.26	93.1	99.0	3.96	75.1
0.59	100.0	2800.0	166.3	141.70	83.0	0.709	152.14	93.1	66.9	2.68	77.3

COST SUMMARY:

Annual Operating Cost @ $0.04 / kwhr = $ 28851.52
8760 hours/year or 100.00%
Total annual operating cost = $ 28851.52
Total kW hours = 721288.04

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VARIABLE SPEED OPERATION: (Table 1 of 1)

System suction pressure: 0.00 ft. (0.00 psig)
Best Efficiency Staging is ON

Hrs	Q/Qd,%	TGPM	TDH,ft	BHP	Ep,%	RPM	HP,in	E,d/m,%	kWHR	$/day	E,w/w,%
6.07	10.0	280.0	26.4	9.49	19.7	672.3	15.82	60.0	71.6	2.86	11.8
4.40	20.0	560.0	30.6	21.98	19.7	728.7	34.66	63.4	113.7	4.55	12.5
2.34	30.0	840.0	37.5	18.03	44.1	811.1	26.90	67.0	46.9	1.88	29.6
2.99	40.0	1120.0	47.2	24.92	53.6	919.6	34.72	71.8	77.4	3.10	38.5
2.51	50.0	1400.0	59.8	34.31	61.6	1041.1	44.52	77.1	83.3	3.33	47.5
1.67	60.0	1680.0	75.0	46.89	67.9	1179.9	58.37	80.3	72.7	2.91	54.5
1.17	70.0	1960.0	93.1	62.98	73.2	1318.8	75.81	83.1	66.1	2.65	60.8
1.34	80.0	2240.0	114.0	83.32	77.4	1457.6	97.71	85.3	97.6	3.91	66.0
0.92	90.0	2520.0	137.6	108.64	80.6	1613.8	125.91	86.3	86.4	3.46	69.5
0.59	100.0	2800.0	164.0	139.87	82.9	1752.6	160.42	87.2	70.6	2.82	72.3

Annual Operating Cost @ $0.04 / kwhr = $ 11482.27
8760 hours/year or 100.00%

Total kW hours = 287056.74

COST SUMMARY:

ction Pressure : 0.0 psig
Percent of Year : 100%
Hours/Year : 8760
Annual Operating Cost: $11482.27

Total hours/year = 8760
Total annual operating cost = $11482.27

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B&G Pumping System Analysis:

SUMMARY OF INPUT DATA: 25910 COOLING Pumps 3+4

System peak demand: 8000.00 gpm
System discharge pressure: 110.00 ft. (47.65 psig)
Minimum control/Static pressure: 25.00 ft. (10.83 psig)

Standard Efficiency (SE) 60-cycle motor.

1 Pump System:

Pump 1: Series HSCS 14X16X17, Impeller diameter 13.400"
Design RPM = 1785.0, Motor HP = 250.00

CONSTANT SPEED OPERATION:

Hrs	Q/Qd,%	TGPM	TDH,ft	BHP	Ep,%	BHP/HP,m	HP,in	E,mtr,%	kWHR	$/day	E,w/w,%
6.07	10.0	800.0	182.4	295.24	12.5	1.181	314.37	93.9	1423.0	56.92	11.7
4.40	20.0	1600.0	178.5	295.24	24.4	1.181	314.37	93.9	1031.5	41.26	22.9
2.34	30.0	2400.0	174.4	293.12	36.1	1.172	312.04	93.9	544.5	21.78	33.9
2.99	40.0	3200.0	169.2	291.36	46.9	1.165	310.10	94.0	691.4	27.66	44.1
2.51	50.0	4000.0	162.8	289.46	56.8	1.158	308.01	94.0	576.5	23.06	53.4
1.67	60.0	4800.0	155.0	287.15	65.4	1.149	305.47	94.0	380.4	15.22	61.5
1.17	70.0	5600.0	145.9	284.68	72.5	1.139	302.75	94.0	264.1	10.57	68.1
1.34	80.0	6400.0	135.4	281.51	77.7	1.126	299.26	94.1	299.0	11.96	73.1
0.92	90.0	7200.0	123.4	277.63	80.8	1.111	295.00	94.1	202.4	8.10	76.1
0.59	100.0	8000.0	110.0	271.95	81.7	1.088	288.78	94.2	127.1	5.08	77.0

COST SUMMARY:

Annual Operating Cost @ $0.04 / kwhr = $ 80882.08
8760 hours/year or 100.00%
Total annual operating cost = $ 80882.08
Total kW hours = 2022051.95

VARIABLE SPEED OPERATION: (Table 1 of 1)

System suction pressure: 0.00 ft. (0.00 psig)
Best Efficiency Staging is ON

Hrs	Q/Qd,%	TGPM	TDH,ft	BHP	Ep,%	RPM	HP,in	E,d/m,%	kWHR	$/day	E,w/w,%
6.07	10.0	800.0	25.9	72.93	7.2	682.2	121.01	60.3	547.7	21.91	4.3
4.40	20.0	1600.0	28.4	47.01	24.4	743.9	73.69	63.8	241.8	9.67	15.6
2.34	30.0	2400.0	32.7	54.99	36.0	832.2	81.31	67.6	141.9	5.68	24.3
2.99	40.0	3200.0	38.6	66.64	46.8	938.0	92.26	72.2	205.7	8.23	33.8
2.51	50.0	4000.0	46.3	82.45	56.7	1061.5	106.26	77.6	198.9	7.96	44.0
1.67	60.0	4800.0	55.6	103.22	65.3	1193.9	128.37	80.4	159.9	6.39	52.5
1.17	70.0	5600.0	66.7	130.25	72.4	1335.0	156.59	83.2	136.6	5.46	60.2
1.34	80.0	6400.0	79.4	165.15	77.7	1485.0	193.46	85.4	193.3	7.73	66.3
0.92	90.0	7200.0	93.8	211.33	80.7	1635.0	244.78	86.3	167.9	6.72	69.7
0.59	100.0	8000.0	110.0	272.56	81.5	1780.6	312.32	87.3	137.4	5.50	71.2

Annual Operating Cost @ $0.04 / kwhr = $ 31114.13
8760 hours/year or 100.00%

Total kW hours = 777853.32

COST SUMMARY:

Suction Pressure : 0.0 psig
Percent of Year : 100%
Hours/Year : 8760
Annual Operating Cost: $31114.13

Total hours/year = 8760
Total annual operating cost = $31114.13

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ECO METHODOLOGY FORM

ECO NAME:	Controls For Supply CHW Regulations/Reset Temperature
ECO NUMBER:	29
TYPE: BLDG SYSTEM:	Bldg. 25910 Cooling
EXISTING CONDITIONS:	Although the chillers are set to maintain a constant chilled water supply temperature, some water is bypassed through non-operating chillers and the temperature actually varies. The system is set to operate at a constant supply water temperature of approximately 42°F.
PROPOSED CHANGE:	Wire the chilled water supply setpoint to existing EMCS controls so that the chilled water temperature setpoint can be adjusted as conditions require. This will allow the temperature to vary upwards, and the savings of 1.5% of the chiller usage can be obtained for every 1° of reset temperature. Although the savings is available to be had, it is recommended that variable speed pumping also be implemented so that flow reduction will be reduced as building loads are reduced, but the chilled water temperature is still increased to 45°F to save additional energy. Each building will still have the full humidity control at 45°F chilled water.
CALCULATION & COST METHODOLOGY	Total chiller usage is determined by the hours each bin of capacity is shown on Table 3A using .75KW/ton-hour.

450 tons x 2262 hours x .75 =	747,900 KW hours
900 tons x 1605 hours x .75 =	1,083,375 KW hours
1350 tons x 853 hours x .75 =	863,663 KW hours
1800 tons x 1092 hours x .75 =	1,474,200 KW hours
2250 tons x 916 hours x .75 =	1,545,750 KW hours
2700 tons x 610 hours x .75 =	1,235,250 KW hours
3150 tons x 428 hours x .75 =	1,011,150 KW hours
3600 tons x 486 hours x .75 =	1,320,300 KW hours
4050 tons x 336 hours x .75 =	1,020,600 KW hours
4500 tons x 215 hours x .75 =	725,625 KW hours
	11,027,813 KW per year

For the available savings,

Multiply 1.5% of 11,027,813 x 50% for all temperatures above 43°F
Multiply 1.5% x 11,027,813 x 20% for all temperatures above 44°F
Multiply 11,027,813 by 10% for all temperatures above 45°F

Total of above equals the total savings.

Above 43°F	82708.60 KWH
Above 44°F	33083.44 KWH
Above 45°F	16541.72 KWH
	132333.76 KWH

$$132333.76 \text{ KWH} \times \frac{3413}{10^6} = 451.655 \text{ Million Btu's/Yr}$$

Cost:

Controls:			
Materials	\$10,000	Labor	\$10,000

CONSTRUCTION COST ESTIMATE	DATE: 23 SEPT 94	SHEET 1 OF 1

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA | **PROJ. NO.**

Arch/Engr: HARRISON AND SPENCER, INC. | **CODE:** BLDG 25910

Summary: ECO #29 - CHW TEMP RESET | **Estimator:** H. TOUB | **Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
CONTROLS	1	LS	10000	10000	10000	10000	$20,000.00
	SUBTOTAL			10000		10000	
	5% SALES TAX			$500.00			
	17% LABOR TAX					$1,700.00	
	SUBTOTALS			$10,500.00		$11,700.00	$22,200.00
	20% OH (GC ONLY)						$4,440.00
	SUBTOTAL GC'S WORK						$26,640.00
	SUBTOTAL(GC & SUBS)						$26,640.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$1,332.00
	TOTAL						**$27,972.00**

ECO METHODOLOGY FORM

ECO NAME: Reduce Make-Up Chilled Water

ECO NUMBER: 33

TYPE: BLDG Bldg. 25910

SYSTEM: Cooling

EXISTING CONDITIONS: There are water meters on the chilled water Zones 1 and 2 to measure the make-up water. In addition to the metered make-up water, there is a fire hose connected, which is unmetered, that supplies water to the chilled water system to maintain a certain supply pressure through the chillers to the various zones. From tests run shutting off pumps, turning valves, and measuring make-up water flow to Zones 1 and 2 chilled water, the leaks are determined to most likely be in the distribution system. Based on HTW meter readings, the leakage rates vary over the course of the year as leaks are found, repaired and developed again. Accurate determination of the make-up water is not possible because the fire hose is connected into the chilled water system, which is unmetered. During field observations it was noted that 29 gpm was expected with flows separately measured from each zone with zones not cross-connected. When they were cross-connected, the flow averaged 12 gpm. Total loss measured for 24 hour period with a 1-1/4 inch branch closed between the make-up water systems was 16,634 gallons, which was less than what was recorded for previous days on the log with the 1-1/4 inch branch open.

PROPOSED CHANGE: Although a permanent fix to all of the leaks is not possible, the effort should be made using permanent flow meters, measuring actual supplies, and determining flow rates within the buildings will help reduce the leakage. The leakage amounts to a large expense due to the chilling required on lost water and the cost of water itself.

CALCULATION & COST METHODOLOGY: The savings consists of water savings and the cost of chilling replacement water. The cost of permanent flow recorders and temperature recording input with wiring of both to the EMCS is included in this ECO, but the EMCS wiring and software changes are shown in the ECO 86 for EMCS controls for this project. Any repair work required to reduce the water leaks is covered by work orders and is not a capital expense for this ECO.

16634 gallons/day

16634 x 8.34 lb/gpm x ($\Delta T = 60° - 45°$) = 2,080,913 Btu/day

at 12,000 Btu/ton = 173 tons

Cooling cost at .75 KWH/ton

.75/KWH/ton x 173 tons =

130 KWH/day saving

x 365 day

47,470 KWH/year or $\frac{47470 \times 3413}{10^6}$ = 162.015 Million Btu's.yr

Water Savings:

16.634 Kgal at $.826/Kgal x 365 days/yr = $5,015/year

CONSTRUCTION COST ESTIMATE | **DATE:** 23 SEPT 94 | **SHEET 1 OF 1**

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA | **PROJ. NO.** 2

Arch/Engr: HARRISON AND SPENCER, INC. | **CODE:** BLDG 25910

Summary: ECO #33 - REDUCE MAKE-UP CHW | **Estimator:** H. TOUB | **Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
FLOW METERS	6	EA	1500	9000	1000	6000	$15,000.00
TEMP RTD IN DISTRIBUTION PIPE	6	EA	500	3000	1000	6000	$9,000.00
	SUBTOTAL			12000		12000	
	5% SALES TAX			$600.00			
	17% LABOR TAX					$2,040.00	
	SUBTOTALS			$12,600.00		$14,040.00	$26,640.00
	20% OH (GC ONLY)						$5,328.00
	SUBTOTAL GC'S WORK						$31,968.00
	SUBTOTAL(GC & SUBS)						$31,968.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$1,598.40
	TOTAL						**$33,566.40**

ECO METHODOLOGY FORM

ECO NAME: Common Manifolding of Cooling Towers

ECO NUMBER: 43

TYPE: BLDG Bldg. 25910
SYSTEM: Cooling

EXISTING CONDITIONS: Chillers 1, 2, 3, 4A, and 4B have dedicated cooling towers and although the towers are similarly sized for 700 and 750 ton chillers, there is no means of using an alternate cooling tower with a desired chiller. Chillers 5, 6, and 7 are centrifugal chillers that replaced two absorption chillers. The cooling towers were not replaced so that two cooling towers are cross-connected for use with three centrifugal chillers. It is not possible to maintain a fixed condenser water flow for three chillers with two cooling towers. The fact that the chilled water flow is only constant through all chillers if the same pumps are "On", no chillers are valved "Off", and the pressure drop through the chilled water distribution systems remain constant does not make a fixed condensate water flow any more likely.

PROPOSED CHANGE: Because the plans for Project 1 calls for eliminating chillers 1, 2, 3, 4A, and 4B and replacing them with three new chillers, of which the tonnage is not matched up with any of the cooling towers, we are going to revise the piping from all cooling towers so that we can establish the correct condenser water flow to any chiller regardless of the cooling towers that are used. The proposed piping and pump arrangement is shown on the drawings for Project No. 1. Each chiller will have its own pump to take water off the loop established by flow through any of the cooling towers in operation. Valving will be available so that the correct flow can be determined, and measured as part of the additional controls that are added. Existing chillers 5, 6, and 7 do not match up with their cooling towers as they are now. The same general approach will apply to them and that pumping and pipes will be added or modified to chillers 5, 6, and 7, similarly to that shown for chiller nos. 1, 2 and 3.

CALCULATIONS AND COST METHODOLOGY:

1. With this ECO and ECO 23 which allows for each individual chillers to be piped out of a loop on the chilled water side we now have the ability to isolate any cooling tower or any chiller to do maintenance work as required. By making repairs when they are necessary instead of when the equipment is available, it can improve the life of the chillers one year. This is the difference between a 19-year life and a 20-year life.

2. With new pumps and valves, the condenser water flow to each chiller can be controlled to optimum conditions. This will allow us to supply water as required and as monitored by the EMCS system to determine what the best efficiency is for that chiller in operation.

3. The condenser water temperature can be controlled by bringing on more cooling towers to bring the temperature down by circulating more water through greater cooling tower capacity. If on hot days we can reduce the condenser water temperature 2 degrees by circulating water through the cooling towers, we can save 1% of yearly cooling tower operating cost of 11,027,813 KW/yr. This equals $110{,}278\text{KW} \times \frac{3{,}413}{10^6} = 376.38$ million Btu's/yr. savings.

   There will be some additional cost of pumping the condenser water through the cooling towers to obtain this saving, but the extra pumping cost will be offset by the reduced pumping cost that can be obtained during the cool weather periods when an efficient condenser water temperature can be obtained with less pumping. Because these savings are marginal and in need of experimental data, the EMCS system will monitor efficiencies of chillers with various condenser water flows, as wells as chilled water flows. The EMCS system controls added in this project will allow the operators to obtain the efficiencies indicated in this ECO. Costs for implementing this ECO are the additional pipe costs.

CONSTRUCTION COST ESTIMATE	DATE: 23 SEPT 94	SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY		
Location: AUGUSTA, GEORGIA		PROJ. NO. 1
Arch/Engr: HARRISON AND SPENCER, INC.		CODE: BLDG 25910
Summary: ECO #43 - COOLING TOWER MANIFOLDING	Estimator: H. TOUB	Checked:

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
PIPING MATERIALS	1	LS	30000	30000	30000	30000	$60,000.00
CONDENSER WATER PUMPS	6	EA	4000	24000	1000	6000	$30,000.00
ELECTRICAL	1	LS	1500	1500	2500	2500	$4,000.00
	SUBTOTAL			55500		38500	
	5% SALES TAX			$2,775.00			
	17% LABOR TAX					$6,545.00	
	SUBTOTALS			$58,275.00		$45,045.00	$103,320.00
	20% OH (GC ONLY)						$20,664.00
	SUBTOTAL GC'S WORK						$123,984.00
	SUBTOTAL(GC & SUBS)						$123,984.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$6,199.20
	TOTAL						**$130,183.20**

ECO NAME:	Cooling Tower Water Treatment
ECO NUMBER:	47
TYPE: BLDG SYSTEM:	Bldg. 25910 Cooling
EXISTING CONDITIONS:	Current water treatment is based on a conductivity meter of the cooling tower water, but biocide is added manually by the scoopful only as needed.
PROPOSED CHANGE:	This cooling tower chemical feed is adequate except for the method of feeding biocides. Proper maintenance and observation of the cooling towers is insufficient without the addition of new equipment. The cost of new equipment is $1000 with $300 for installation labor.
CALCULATION & COST METHODOLOGY:	Savings amount to the increased life of the cooling tower and improved cooling by keeping it clean. Because chemicals are now being added, there is no increased cost of chemicals. Any improvements in the cooling water chemical treatment will be positive; a potential maintenance cost reduction of $2,500/year total, and the life of the cooling tower extended for two years (with treatment, the life of the cooling tower is 20 years, without treatment it is 18 years). The cost of a new cooling tower is $20,000 in materials and $4,000 in labor for each of six towers in Building 25910. The total cost is therefore $144,000 for six new cooling towers.

The efficiency improvement of the chillers will be 1% if the cooling tower water can be cooled two degrees F more than it is cooled in a algea laden cooling tower. Based on ECO 29 calculation and cost methodology, the chillers use 11,027,813 KW/year.

1% of 11,027,813 KW/yr = 110,278 KW/yr

$$110{,}278 \times \frac{3413}{10^6} = 376.38 \text{ million BTU's/yr.}$$

CONSTRUCTION COST ESTIMATE				DATE: 23 SEPT 94		SHEET 1 OF 1	
Project: FORT GORDON ENERGY STUDY							
Location: AUGUSTA, GEORGIA					PROJ. NO. 1		
Arch/Engr: HARRISON AND SPENCER, INC.					CODE: BLDG 25910		
Summary: ECO #47 WATER TREATMENT		Estimator: H. TOUB			Checked:		

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
CHEMICAL FEED	1	LS	1000	1000	300	300	$1,300.00
	SUBTOTAL			1000		300	
	5% SALES TAX			$50.00			
	17% LABOR TAX					$51.00	
	SUBTOTALS			$1,050.00		$351.00	$1,401.00
	20% OH (GC ONLY)						$280.20
	SUBTOTAL GC'S WORK						$1,681.20
	SUBTOTAL(GC & SUBS)						$1,681.20
	10% GC'S PROFIT						
	5% CONTINGENCY						$84.06
	TOTAL						**$1,765.26**

ECO METHODOLOGY FORM

ECO NAME:	Free Cooling In Lieu of Chiller Operation
ECO NUMBER:	51
TYPE: BLDG SYSTEM:	Bldg. 25910 Cooling
EXISTING CONDITIONS:	All of the chillers in Building 25910 are either Carrier or York and are not internally convertible to free cooling unless a heat exchanger is added externally.
PROPOSED CHANGE:	Add a plate heat exchanger to allow the cooling tower to provide the necessary cooling for the chilled water system in the winter months. With new valves and pumps to be added to each chiller in Project No. 1, flow will not go through the chiller pumps that are not turned on. When the piping is designed, the new variable speed drives should be made to have a lower pressure drop through the heat exchanger than the chillers if possible.
CALCULATION & COST METHODOLOGY:	Free cooling with non-Trane chillers is based on the KWH of 193,759 KW hours at $.052 per KW hours which equals $10,075.47. The cost is based on adding piping and one plate heat exchanger, which cost $20,000 in material and $25,000 in labor. Additional savings will be obtainable in winter days when chilled water that is made with this free cooling system is stored in the chilled water storage tank. This will eliminate running the chillers during the winter days when the cooling load is low and free cooling is not available.

TABLE 2

Month	Time Period	Operating Hours	Free Cooling Avg. Tons	Ton Hrs.	KW/Ton EFF	KWH Saved
	01-08	21	66	1386	.66	915
Oct	09-16	0	1069	0	.66	0
	17-24	4	580	2320	.66	1531
	01-08	78	60	4680	.66	3089
Nov	09-16	4	903	3612	.66	2384
	17-24	30	546	16380	.66	10811
	01-08	166	46	7636	.66	5040
Dec	09-16	64	798	51072	.66	33708
	17-24	116	448	51968	.66	34299
	01-08	170	29	4930	.66	3254
Jan	09-16	78	660	51480	.66	33977
	17-24	118	386	45548	.66	30062
	01-08	93	40	3720	.66	2455
Feb	09-16	20	619	12380	.66	8171
	17-24	38	387	14707	.66	9706
	01-08	63	57.	3591	.66	2370
Mar	09-16	7	910	6370	.66	4204
	17-24	17	576	9792	.66	6463
	01-08	13	104	1352	.66	892
Apr	09-16	0	1210	0	.66	0
	17-24	1	648	648	.66	428
					Total KWH	193,759

Converting free cooling to millions of Btu's/Yr. → $193{,}759 \text{ KW} \times \frac{3413}{10^6} = 661.3$ Million Btu's/Yr.

ECO METHODOLOGY FORM

ECO NAME:	Free Cooling In Lieu of Chiller Operation (Cont'd)
ECO NUMBER:	51
TYPE: BLDG	Bldg. 25910
SYSTEM:	Cooling

CALCULATION & COST METHODOLOGY:

Storage capacity is 7378 ton hours for a 1,061,547 gallon storage tank.
The total cooling tonnage for each month per Table 2A is:

October = 27,432 ton hours
February = 16,714 ton hours, which is the lowest monthly load for chilling

From Table 2 above, the free cooling available in February is:

93 hrs	@ 40 tons	=	3,720 ton hours
20 hrs	@ 619 tons	=	12,380 ton hours
38 hrs	@ 387 tons	=	4,707 ton hours
151 hrs			30,807 ton hours

In February there are 28 days x 24 hrs/day = 672 hours. Since only 151 hours are available for free cooling, the remaining hours are too warm outside for free cooling so a chiller may be required.

If 7378 ton hours are available each day from the chilled water storage, then 30,807 ton hours can be used directly and 7378 x 28 day/mo = 206,584 ton hours are available from storage with free cooling if every night has some time when the outside temperature is low enough to make chilled water for storage and to supply the distribution system demand. The total cooling required in February is 16,714 ton/hrs/day x 28 = 467,992 ton hrs/mo.

Since each day chilled water can be supplied with the free cooling system as follows:

Direct Usage	30,807 ton hrs.
Storage	206,584 ton hrs
	237,391 ton hrs.

$\frac{237,391}{467,992}$ = 50% of February's full load can be met by free cooling with the use of the storage tank.

We will assume that a full storage tank can be made from the free cooling heat exchanger every night in December, January, and February and half of November and March

120 days x 7378 ton hrs. x .66 KW/ton = 584,338 KWH which is saved in addition to the 193,759 KWH shown in Table 2.

Total Savings:

193,759 + 584,338 = 778,097 KWH

Converted to Btu x 10^6:

$778{,}097 \times \frac{3413}{10^6} = 2655.64$ Million Btu's/Yr.

CONSTRUCTION COST ESTIMATE	DATE: 23 SEPT 94	SHEET 1 OF 1

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA — PROJ. NO. 1

h/Engr: HARRISON AND SPENCER, INC. — CODE: BLDG 25910

Summary: ECO #51 - FREE COOLING — Estimator: H. TOUB — Checked: X

ITEM DESCRIPTION	QUANTITY QUAN	QUANTITY UNIT	MATERIAL UNIT COST	MATERIAL EXTENSION	LABOR UNIT COST	LABOR EXTENSION	TOTAL
MODIFY COOLING TOWER W/ HEAT EXCHANGER	1	LS	40000	40000	25000	25000	$65,000.00
	SUBTOTALS 1			$40,000.00		$25,000.00	$65,000.00
	5% SALES TAX			$2,000.00			$2,000.00
	17% LABOR TAX					$4,250.00	$4,250.00
	SUBTOTALS 2			$42,000.00		$29,250.00	$71,250.00
	20% GC OH & PROFIT						$14,250.00
	SUBTOTAL GC WORK						$85,500.00
	TOTAL SUB WORK						
	10% GC SUB PROFIT						
	5% CONTINGENCY ON JOB						$4,275.00
	TOTAL						$89,775.00

ECO METHODOLOGY FORM

ECO NAME: Chilled Water Storage

ECO NUMBER: 53

TYPE: BLDG — Bldg. 25910

SYSTEM: Cooling

EXISTING CONDITIONS: As the chilled water system requires chilling, the only way to satisfy this now is by the chillers to operate.

PROPOSED CHANGE: Chilled water storage tanks should be obtained and installed in back of the plant and piped accordingly. Storage capacity will be slightly over 1 million gallons which will allow the existing chiller system to not go over 2,900 tons. According to calculations, the present capacity indicates the capacity would exceed 4,400 tons on a peak day in June. Piping to and from the tank will be as shown on Project No. 1 drawing, and the concept will be that water coming in from the return of the system will come into the high side of the tank, and the water leaving will be on the low side. During the discharging of the stored chilled water, the flow in the piping will be reversed when chilled water is being stored in the tank. Through stratification, the temperatures will vary from the top to the bottom of the tank. The size of the tank will be approximately 50 feet high with a 60 foot diameter. There will be a pump added in case the return pressure from the chilled water system is not sufficient to get to the height of the top of the tank, which will only be used if necessary to get the flow into the tank when required. This will have to be a controlled pump operation.

CALCULATION & COST METHODOLOGY: Table 2A included with ECO 85, each month by the hour, is broken down by tonnage supplied to the distribution system. This tonnage is calculated based on our field investigation which involved heat gain calculations on all of the buildings and totalizing them. It does not take into account any line loss because the temperature difference in the chilled water system is minimal with direct exchange with the earth. Maximum calculated tonnage occurs at 1500 hours on June, which is 4426 tons. All other hours are less than this. Roughly, 4400 tons of chiller capacity would be needed to meet all demands on the system as it currently is now. The intent of this ECO is to supply chilled water so that less chilling capacity is actually installed and needed than the amount of tonnage required for the period of any day where it exceeds 2900 tons. The difference in tonnage between the maximum demand and the installed capacity of the chillers will be supplied by the chilled water storage system. 2900 tons was selected because this number includes most hours in the summer time in the peak demand for electricity. Below 2900 hours, the cooling demand falls off rapidly so that for every hundred tons less than 2800, Fort Gordon will not have any more time when operating the chilled water storage system to meet Georgia Power's interruptible rate requests. Creating the demand savings will only be a matter of controlling the demand by maintaining enough chilled water in the storage system to get through the peak. As you will see from ECO 51 for free cooling, the storage system is also used in the winter time so that if funds are available to increase the storage size, there are still some possibilities that it would pay for itself from additional free cooling in the winter and from reducing the demand slightly in the summer. In accordance with Table 2A calculations, June being the worst month, the hours where it exceeds 2900 is taken:

ECO METHODOLOGY FORM

ECO NAME: Chilled Water Storage (Cont'd)

ECO NUMBER: 53

TYPE: BLDG Bldg. 25910

SYSTEM: Cooling

CALCULATION & COST METHODOLOGY:

Hours	Demand Above 2900 Tons
0010	174
0011	485
0012	792
0013	1045
0014	1335
0015	1526
0016	727
0017	757
0018	437
	7378 ton hrs.

Since the chilled water storage tank will be charged to 42°F water, it will be ready for use in the morning starting at 1000 hours. The capacity of the tank will be based on 10°F difference from 42°F to 52°F. Converting this to the Btu's required to get 7,378 ton hour, the following method is calculated:

1 ton hour = 12,000 Btu/hr = 1,200 lbs. water x 10°F Δt
1,200 lbs. ÷ 8.34 lbs/gal. = 143.88 gal./ton hr.
1,200 lbs ÷ 62.4 lbs/cu. ft. = 19.23 cu. ft./ton hr.
7378 ton hr x 143.88 gal/ton hr. = 1,061,547 gal. capacity
7378 ton hours x 19.23 cu. ft./ton hr. = 141,885 cu. ft.
Tank size with diameter roughly equals to height $\frac{\Pi D^2}{4} \times H = V$

Where H = D, $D^3 = \frac{V \times 4}{\Pi} = 141{,}885 \times 4 \div \Pi$

$D^3 = 180{,}654, D = 56.5$

The above calculation was for 2900 tons of chiller demand capacity with a 7,378 ton hour capacity. Basis of selection therefore indicates that a 60 ft. diameter tank at 50 ft. high would satisfy the 2900 tons of chiller demand. Another 300,000 gal. of capacity, that would be necessary to reduce the electrical demand to 2700 tons of chiller capacity, would require that the 60 ft. diameter tank be 10 feet taller. We would only get 200 tons of additional chiller capacity which would minimally affect the time that electrical demand would have to be reduced to meet the Power company's curtailment. EMCS building controls would reduce usage before this 200 ton hour demand decrease would influence electric building. The additional 200 ton hour will only be cost effective if a new low demand can be set for the Georgia Power interruptible rate.

The cost of chilled water storage: The rough cost that seems to work is $60/ton hr.
$60/ton hr x 7,378 ton hrs. = $442,680. Of this total, the labor portion of this is roughly $42,680.

ECO METHODOLOGY FORM

ECO NAME: Chilled Water Storage (Cont'd)

ECO NUMBER: 53

TYPE: BLDG Bldg. 25910
SYSTEM: Cooling

CALCULATION & COST METHODOLOGY:

The current arrangement with Georgia Power and Fort Gordon is that the demand charge is at a rate of $106.20, but there is a $45/KW rebate if they can meet an interruptible rate when asked by Georgia Power to reduce their demand, in the summer time and usually at the peak couple of hours during the day. Adding the peak demand of $106.20 to the $45/KW rebate is a savings of $151.20/KW if the demand can be reduced, which it can be in this case. Existing chiller operating cost is .66 KW/ton for the chiller, and .12 KW/ton for the fans and pumps on the cooling towers, which would not have to operate with stored chilled water. The total demand savings is a total of .78 KW/ton. Difference in demand between the full chiller capacity of 4426 tons and 2900 tons is 1526 tons for the maximum cooling day in June.

1,526 x .78 KW/ton = 1,190.28 KW demand
1,190.28 KW x $151.20 = $179,970.34 savings for demand reduction

CONSTRUCTION COST ESTIMATE				DATE: 23 SEPT 94		SHEET 1 OF 1	
Project: FORT GORDON ENERGY STUDY							
Location: AUGUSTA, GEORGIA					PROJ. NO. 1		
Arch/Engr: HARRISON AND SPENCER, INC.					CODE: BLDG 25910		
Summary: ECO #53 - Chilled Water Storage			**Estimator:** H. TOUB		**Checked:**		

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
INSTALL UNDERGROUND CHILLED WATER TANK	1	LS	400000	400000	42650	42680	$442,680.00
	SUBTOTALS 1			$400,000.00		$42,680.00	$442,680.00
	5% SALES TAX			$20,000.00			$20,000.00
	17% LABOR TAX					$7,255.60	$7,255.60
	SUBTOTALS 2			$420,000.00		$49,935.60	$469,935.60
	20% GC OH & PROFIT						$93,987.12
SUB-CONTRACTORS	SUBTOTAL GC WORK						$563,922.72
	TOTAL SUB WORK						
	10% GC SUB PROFIT						
	5% CONTINGENCY ON JOB						$28,196.14
	TOTAL						$592,118.86

ECO METHODOLOGY FORM

ECO NAME:	Replace Chillers in Plants for Higher Efficiency and the Best Sizing
ECO NUMBER:	85
TYPE: BLDG SYSTEM:	Bldg. 25910 Cooling
EXISTING CONDITIONS:	See Figure 1A for the existing chilled water schematic for Building 25910. Chillers 1, 2, and 3 are the oldest; chillers 4A and 4B are next in age and next to lowest in efficiency; chillers 5, 6, and 7 were recently added to the Plant to be replaced in lieu of the absorption chillers which have been removed and are the most efficient. Chillers 1, 2, and 3 are 700 ton capacity; chillers 4A and 4B are both 750 ton capacity.
PROPOSED CHANGE:	Replace all five chillers that are the oldest, 1, 2, 3, 4A and 4B with new chillers of high efficiency in the following capacities: One 400 ton chiller and two 1250 ton chillers. This will give the capacity of 2900 tons, which is what is required with the chilled water storage being put in to maintain the full demand of 4426 tons, which will occur at the highest peak demand in one hour in June. The remaining existing chillers 5, 6, and 7 are the newest and will remain in place, to act as a back-up in case there is any failure in the new chillers being installed. When these new chillers are installed, there will be piping changes for the incoming condenser water, as well as the chilled water entering and leaving the chillers, but the piping cost and piping identification will occur in other ECO's in this Project No. 1.
CALCULATION & COST METHODOLOGY:	The new chillers are more efficient than the existing chillers. This information is shown on the sheet that shows chiller efficiencies. Bin limits and the chillers that are operating for those various capacities are shown on Page 2 of this ECO. Page 3 and 4 show the cost of operating the new chillers under Savings No. I of Page 3, and under Savings No. II the existing chiller operating cost is shown. The existing chiller cost is based on most efficient operation of the existing chillers. This is a conservative approach because (1) it is not known how the operators are going to operate which chiller at which time, and (2) the information available about the efficiencies of the chillers is sketchy based on previous reports by GEC Jenson which are the basis of this report. Only three of the 8 chillers have been tested, and the report of the efficiency is widely varied. I have chosen the best efficiencies to operate most of the time, and I have assumed that all chillers that were not tested operated at these best efficiencies. III on Page 4 of this ECO shows that there is a savings of 2,310,133 KWH/yr, which translates into 7,884.48 million Btu's. Because new chillers are replacing old, the maintenance costs will decrease by $2,000/yr.

ECO METHODOLOGY FORM

ECO NAME: Replace Chillers in Plants for Higher Efficiency and the Best Sizing (Cont'd)

ECO NUMBER: 85

TYPE: BLDG Bldg. 25910
SYSTEM: Cooling

CALCULATION & COST METHODOLOGY:

New

1250 Ton Unit (Based on Trane Information)

Capacity	Electric Usage
100%	.54 KW/ton
75%	.49 KW/ton
50%	.48 KW/ton
25%	.55 KW/ton

400 Ton Unit

Capacity	Electric Usage
100%	.58 KW/ton
95%	.53 KW/ton
50%	.52 KW/ton
25%	.59 KW/ton

Existing

750 Tons, Chillers 4A and 4B

Capacity	Electric Usage
100%	13.80
80%	13.52
65%	12.27
50%	12.00

700 Ton Chillers 1, 2, and 3, 5647

Capacity	Electric Usage
100%	18.51
80%	19.07
65%	19.31
50%	19.18

ECO METHODOLOGY FORM

ECO NAME: Replace Chillers in Plants for Higher Efficiency and the Best Sizing (Cont'd)

ECO NUMBER: 85

TYPE: BLDG Bldg. 25910
SYSTEM: Cooling

CALCULATION & COST METHODOLOGY: Chiller Cooling Summary - Project No. 1 (See Table 3A for Plant Cooling Load Summary)

Existing Chiller Operating (Quantity)	New Chiller Capacity Operating (Tons)	c/o Plant Capacity	BIN Limit Tons	Hours Per BIN
Qty of 7	Chillers 1,2,3, = 2900	100	4500	215
Qty of 6	Plus Storage	90	4050	336
Qty of 5	Plus Storage	80	3600	489
Qty of 5	Plus Storage	70	3150	428
Qty of 4	Plus Storage	60	2700	610
Qty of 4	Chillers 2 and 3	50	2250	916
Qty of 3	Chillers 2 and 3	40	1800	1092
Qty of 2	Chillers 1 and 3	30	1350	853
Qty of 2	Chiller 3	20	900	1605
Qty of 1	Chiller 3	10	450	2216

New

Chiller 1	=	400 tons
Chiller 2	=	1250 tons
Chiller 3	=	1250 tons
		3050 tons

Existing

Chiller 4A	=	750 tons
Chiller 4B	=	750 tons
Chiller 1	=	700 tons
Chiller 2	=	700 tons
Chiller 3	=	700 tons
Chiller 5	=	700 tons
Chiller 6	=	700 tons
Chiller 7	=	700 tons
		5,700 tons

ECO METHODOLOGY FORM

ECO NAME: Replace Chillers in Plants for Higher Efficiency and the Best Sizing (Cont'd)

ECO NUMBER: 85

TYPE: BLDG Bldg. 25910
SYSTEM: Cooling

CALCULATION & COST METHODOLOGY:

I. SAVINGS: (Cost of Operating New Chillers)

% CAP	HRS.	TONS	KW/TON	KWH
100%	1468	2500	.54	1,981,800
thru 70%		400	.58	340,576
60%	610	2500	.54	823,500
		200	.52	63,440
50%	916	1250	.54	618,300
		1000	.50	458,000
40%	1092	1800	.49	963,144
30%	853	950	.49	397,072
		400	.58	197,896
20%	1605	900	.49	707,805
10%	2216	450	.52	518,544
			Total	7,070,077

ECO METHODOLOGY FORM

ECO NAME: Replace Chillers in Plants for Higher Efficiency and the Best Sizing (Cont'd)

ECO NUMBER: 85

TYPE: BLDG Bldg. 25910
SYSTEM: Cooling

CALCULATION & COST METHODOLOGY:

II. SAVINGS: - Existing Chiller Operating Cost

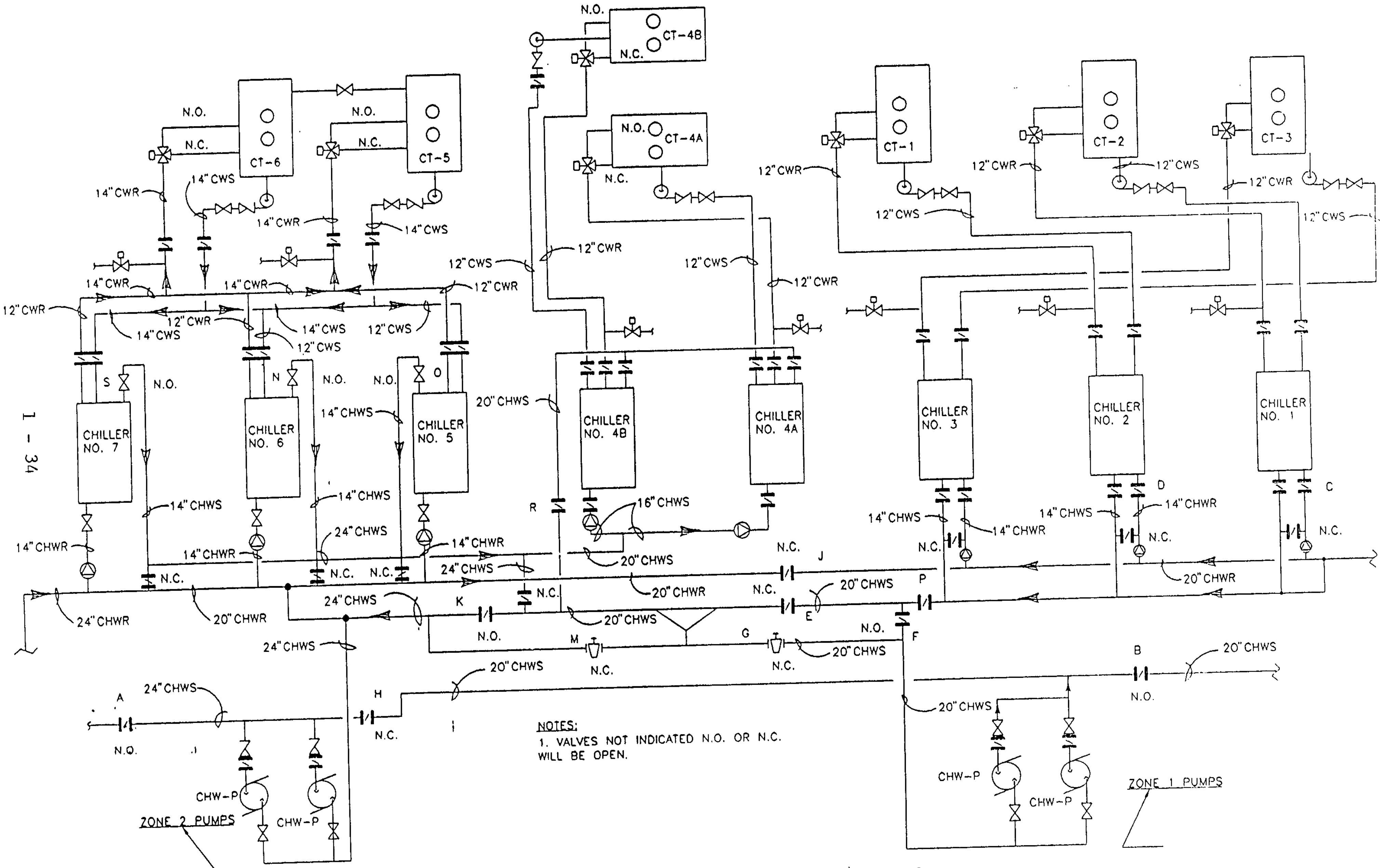
A	B	C	D	E	F
			MBTU/HR		KW/HR
% CAP	HRS	TONS	TONS X 12	EER	(BXD/E)
100%	215	4,200	50,400	18.51	585,413
		300	3,600	12.00	64,500
90%	336	4,050	48,600	18.51	882,204
80%	489	3,600	43,200	18.93	1,115,943
70%	428	3,150	37,800	18.78	861,470
60%	610	2,700	33,400	18.55	1,065,445
50%	916	2,250	27,000	19.07	1,296,906
40%	1,092	1,800	21,600	18.93	1,246,022
30%	853	1,350	16,200	18.55	744,938
20%	1,605	900	10,800	19.31	897,670
10%	2,216	450	5,400	19.31	619,700
					9,380,210

III. TOTAL SAVINGS - New High Efficiency Chiller vs. Existing chillers Operating at Best Efficiency

Difference from I and II above 9,380,210
(7,070,077)
2,310,133 KWH Savings/Yr.

Annual Savings in Million Btu's

$$\frac{2{,}310{,}133 \times 3{,}413}{10^6} = 7{,}884.48 \text{ Million Btu}$$



NOTES:
1. VALVES NOT INDICATED N.O. OR N.C. WILL BE OPEN.

CHILLED WATER SCHEMATIC-BLDG. 25910

CONSTRUCTION COST ESTIMATE | **DATE:** 23 SEPT 94 | **SHEET 1 OF 1**

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA | **PROJ. NO.** 2

Arch/Engr: HARRISON AND SPENCER, INC. | **CODE:** BLDG 25910

Summary: ECO #85 - REPLACE CHILLERS | **Estimator:** H. TOUB | **Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	QUANTITY UNIT	MATERIAL UNIT COST	MATERIAL EXTENSION	LABOR UNIT COST	LABOR EXTENSION	TOTAL
NEW 400 TON CHILLER INSTALLATION	1	LS	110,000	110,000	20,000	20,000	$130,000.00
NEW 1250 TON CHILLER	2		280,000	560,000	20,000	40,000	$600,000.00
	SUBTOTAL			670,000		60,000	
	5% SALES TAX			$33,500.00			
	17% LABOR TAX					$10,200.00	
	SUBTOTALS			$703,500.00		$70,200.00	$773,700.00
	20% OH (GC ONLY)						$154,740.00
	SUBTOTAL GC'S WORK						$928,440.00
	SUBTOTAL(GC & SUBS)						$928,440.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$46,422.00
	TOTAL						**$974,862.00**

ECO METHODOLOGY FORM

ECO NAME:	EMCS Controls and Instrumentation for New Project No. 1
ECO NUMBER:	86
TYPE: BLDG SYSTEM:	Bldg. 25910 Cooling

EXISTING CONDITIONS:

Existing automatic or manual controls that are within the plant are not remotely operable by the EMCS by design. The EMCS office which is manned 24 hours a day has very few, if any, instrumentation readouts from the plant, and no control of the plant with the EMCS. Because EMCS personnel are aware of what is happening in many buildings, they are also aware of conditions and demands in the chilled water system. Currently, the boiler operators are making boiler pressure changes, HTW changes, bringing on and off chillers, cooling towers, and many manual valving operations. However, they are not performing the functions that an EMCS office can to control energy and to improve the operating efficiency of the plant.

PROPOSED CHANGE:

It is proposed that the instrumentation discussed in other ECO's related to this Project No. 1 be wired as part of this ECO. Controls that are necessary to obtain maximum operating efficiency will be included in the EMCS software if it is not already there. The wiring from the instrumentation that is referred to in other ECO's and the connections to the EMCS system computer will be included in this ECO computation. Proposed additions or revisions to the EMCS program are as follows:

DESCRIPTION	NO. POINTS	DOLLARS
Software for computing chiller efficiency with BTU measurement	- -	$ 10,000
Wiring for flow meters at distribution pipe locations	10	5,000
Wiring of temperature sensors at distribution pipe locations	10	5,000
Operating controls for chillers, pumps and valves and indications that they are on	14	4,200
Temperature of chilled water, condenser water, etc.	6	1,200
Free cooling valve positions	4	800
Flow directions to and from chilled water storage	4	6,000
Amps on chillers	7	2,800
Pressures on chilled water supply return and piping to storage	6	1,800
Variable speed pump controls with switches	7	2,500
Chiller pump controls	7	2,500
Condenser water pump controls	6	2,000
Total		$43,800

This assumes that no additional manpower will be required by EMCS personnel, nor will there be any reduction of personnel in the plant to operate the valves. However, the change that will occur is that EMCS personnel will actually have either physical control or the ability to tell people in the Plant to change valve positions or start equipment.

CALCULATION & COST METHODOLOGY:

It is conservatively estimated that at least 3% of the operating cost for chillers, cooling towers, fans, and pumps, can be saved if the EMCS system is properly controlled and valves properly switched, pumps properly operated, and if the supervision of operating personnel within the Plant is the responsibility of the EMCS personnel using controls and instrumentation to operate plant

ECO METHODOLOGY FORM

ECO NAME: EMCS Controls and Instrumentation for New Project No. 1 (Cont'd)

ECO NUMBER: 86

TYPE: BLDG Bldg. 25910

SYSTEM: Cooling

CALCULATION & COST METHODOLOGY:

equipment either automatically or by directing the on-site operator by telephone. Savings will be obtained from chiller operation by optimizing the free cooling system so that the chilled water can be stored in the winter, in addition to operating free cooling when ambient temperatures are proper for free cooling, and from locating water leaks in the system using new instrumentation to be installed and monitored by EMCS equipment. From Table 2A, we can count 44 hours listed where the tonnage required per hour is greater than 2900 tons, and for the rest of the hours per year some chilled water, less than 2900 tons, is required. The average tonnage in all hours per year when the full capacity is not required is 1300 tons/hr.

44 hours x 30 days/mo. = 1,320 hrs x 2900 tons x .78 KW/ton = 2,985,840 KW
(8760 - 1320 hrs.) x 1,300 tons(average) x .78 KW/ton = 7,544,160 KW
Total = 10,530,000 KW

10,530,000 KW x $.052/KW = $547,560
1% of $547,560 = $ 5,476
2% of $547,560 = $10,951.20
3% of $547,560 = $16,426.80

The actual KW saved is 10,530,000 KW x .03 = 315,900 KW

$$315{,}900 \text{ KW} \times \frac{3{,}413}{10^6} = 1078.17 \text{ million Btu's}$$

The costs of the instrumentation are identified in the table under Proposed Changes.

CONSTRUCTION COST ESTIMATE					DATE: 23 SEPT 94		SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY							
Location: AUGUSTA, GEORGIA					PROJ. NO. 2		
Arch/Engr: HARRISON AND SPENCER, INC.					CODE: BLDG 25910		
Summary: ECO #86 - EMCS CONTROLS		Estimator: H. TOUB			Checked:		

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
CHILLER EFFIENCY SOFT WARE	1	LS			10000	10000	$10,000.00
DISTRIBUTION SYSTEM FLOW METERS	1	LS	3000	3000	2000	2000	$5,000.00
DISTRIBUTION SYSTEM FLOW METERS	1	LS	3000	3000	2000	2000	$5,000.00
OPERATING CONTROLS - CHILLERS, VALVES	1	LS	3500	3500	700	700	$4,200.00
TEMPS - CHW, COND WATER	1	LS	200	200	1000	1000	$1,200.00
FREE COOLING VALVE INDICATORS	1	LS	400	400	400	400	$800.00
FLOW SWITCHES - CHW STORAGE	1	LS	5200	5200	800	800	$6,000.00
CHILLER AMPS	1	LS	2000	2000	800	800	$2,800.00
PRESSURES - CHW RET, SUPPLY AND STORAGE	1	LS	900	900	900	900	$1,800.00
VARIABLE SPEED & SWITCH CONTROL	1	LS	1000	1000	1500	1500	$2,500.00
CHILLER PUMP CONTROLS	1	LS	1000	1000	1500	1500	$2,500.00
CONDENSER PUMP CONTROLS	1	LS	800	800	1200	1200	$2,000.00
	SUBTOTALS 1			$21,000.00		$22,800.00	$43,800.00
	5% SALES TAX			$1,050.00			$1,050.00
	17% LABOR TAX					$3,876.00	$3,876.00
	SUBTOTALS 2			$22,050.00		$26,676.00	$48,726.00
	20% GC OH & PROFIT						$9,745.20
SUB-CONTRACTORS	SUBTOTAL GC WORK						$58,471.20
	TOTAL SUB WORK						
	10% GC SUB PROFIT						
	5% CONTINGENCY ON JOB						$2,923.56
	TOTAL						$61,394.76

COOLING [illegible]LE BUILDING 25910

JANUARY

DAY HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
	BUILDING TYPE																																				
1										0.1			1.1		15.5					23.4					2.4			38.7					4.3	0.7	0.8		119.1
2									1.2	0.8	0.2				16.2					1.4					4.1			25.0							1.3		82.6
3															11.5					10.2							3.6	12.7									61.0
4															10.6					5.2								4.1							1.3		42.4
5															9.2																						27.6
6															7.6																						22.8
7															6.0																						18.0
8															3.9					186.2													0.7				200.6
9															4.2					230.5								134.5					42.5				420.1
10		2.3						7.2						0.1	3.7	58.8	42.2			251.4	3.2				22.5	81.3		201.1					45.3		1.4	64.1	798.7
11		3.7						13.3						4.0	3.5	59.5	92.5		22.0	266.1	45.3				53.2	108.5		215.3					49.6		34.9	138.9	1130.7
12	7.0	4.8			0.2			2.0					13.8	4.3	3.3	65.2	99.5		62.7	281.5	50.2	1.3			64.9	116.1		226.0					52.5	12.6	39.7	153.1	1330.0
13	3.2	5.7		7.2	3.4	0.2		1.8				6.5	14.9	4.7	3.5	72.1	106.8		67.2	283.0	55.1	19.2			133.0	123.4	24.8	235.1		37.3	3.1		54.3	15.0	49.7	165.5	1570.6
14	3.8	6.4		21.5	4.0	3.2		2.0	1.4			10.4	16.3	5.2	4.0	78.7	114.7	4.3	73.8	302.8	59.5	22.8			139.8	130.9	37.1	243.9		45.2	14.7		56.8	17.3	53.9	176.1	1732.9
15	4.1	7.4		17.8	4.7	3.7		2.6	3.9			11.7	17.3	5.6	4.0	83.5	119.7	4.6	77.9	370.5	63.3	25.7			146.9	136.4	40.9	250.6	38.8	49.8	16.7	37.1	58.8	19.8	57.5	184.7	1955.9
16	4.2	8.2		16.2	5.1	4.1		3.0	3.3			12.7	18.1	6.0	3.3	32.7	46.3	4.8	31.2	359.9	66.4	27.3			53.1	26.3	44.3	256.6	51.1	53.6	1.2	41.9	61.1	21.7	60.8	189.6	1607.9
17	3.9	7.9		20.0	5.2	4.2		2.5	3.0			13.0	18.4	6.1	2.9	20.5	31.6	4.8	20.3	364.0	66.4	27.6			42.6	20.0	46.1	259.3	53.6	55.3		43.2	62.2	23.1	62.4	190.5	1574.4
18	3.1	6.6		20.4	4.8	3.9			1.5			3.4	18.6	6.1	3.2	12.5	19.9	0.9	11.1	362.4	9.8	26.2			26.0	13.7	9.2	259.6	19.9	53.8		42.9	62.3	24.0	20.7	188.2	1306.6
19		0.5		11.0					1.4			0.5	18.5	1.8	4.4	7.2	12.6		5.5	136.6	5.1	5.4			12.5	7.5	5.2	257.9	10.4	13.1		41.4	62.1	23.5	12.9	75.1	762.7
20				4.0					1.2				18.4	0.9	8.0	3.8	6.1			93.8		1.6			4.4	2.2		255.4	2.3	5.6		39.6	60.9	22.6	7.7	50.6	624.4
21									0.3				18.2	0.2	10.9		1.5			70.7					1.5			251.4				36.9	59.4	21.0	4.1	33.8	550.1
22													17.9		13.2					54.8					2.3			245.0				33.1	57.8	19.4	0.7	20.9	509.4
23										0.2			5.4		1.0					42.4					3.6			239.3				29.5	56.1	19.4	1.3	11.4	417.0
24									0.3	0.1			2.6		13.3					32.1					4.7			235.9				26.9	54.4	19.0	1.7	2.9	423.5

FEBRUARY

DAY HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
	BUILDING TYPE																																				
1													1.6		10.7					25.2					1.8			42.3				2.0	6.7	1.6			114.9
2													0.4		12.8					18.4					3.1			28.9					2.7		0.9		93.2
3									0.7						11.5					12.1					4.3			16.7							0.9		69.2
4															10.3					7.3							3.4	7.2									48.8
5															9.9					3.2																	32.9
6															9.7																						29.1
7															9.2																						27.6
8															8.6					192.7													6.3				223.8
9								2.2							8.3					230.5								137.0					42.7		0.7		436.0
10		1.0						10.1	1.5					1.0	7.3	33.4	43.5			251.4	11.5				31.7	84.2	0.8	190.3					43.8	6.4	8.9	47.5	791.9
11		2.3						11.9	0.9					3.3	6.4	43.8	75.2		37.9	267.7	42.5				50.1	94.3		202.0					47.0	6.7	30.0	114.4	1057.1
12		3.6						0.5		0.3			13.1	3.8	6.0	53.6	86.5		47.4	281.1	47.7				74.7	104.1	6.4	214.0					49.7	8.9	35.7	133.4	1206.6
13	2.9	4.6		5.9	3.0			0.5				2.6	14.2	4.4	6.2	62.5	97.7		57.4	292.5	52.5	15.7			129.3	114.4	23.5	226.0					52.6	11.3	45.7	150.4	1433.7
14	3.5	5.7		16.6	3.6	3.0		0.5	1.5			9.4	15.7	4.9	6.0	70.2	106.4	4.1	65.2	302.0	56.9	20.0			137.2	123.1	29.8	236.2		31.6	12.9		54.9	14.1	50.7	164.6	1631.3
15	4.0	6.4		14.3	4.3	3.6		1.0	3.9			11.3	16.9	5.4	5.6	76.0	113.1	4.5	71.3	324.0	61.0	23.7			147.0	130.8	35.3	245.0	1.7	42.5	15.9	20.2	57.8	16.6	55.0	174.9	1782.3
16	4.1	7.1		13.5	5.0	4.0		1.2	3.6			12.5	17.6	5.7	4.4	31.0	43.8	4.6	29.1	357.1	63.9	25.6			52.7	23.5	39.2	250.6	44.4	47.0	0.9	38.3	59.7	18.9	57.9	182.1	1540.9
17	4.0	7.6		17.2	5.2	4.3		0.6	3.1			12.9	18.0	5.9	3.5	19.5	30.3	4.7	19.4	363.0	66.0	27.0			43.6	18.2	41.2	255.1	47.7	48.9		40.9	61.2	20.1	60.6	185.9	1528.9
18	3.5	7.2	1.1	18.7	5.2	4.3			2.2	1.6	1.2	4.0	18.3	6.0	2.9	12.0	19.9	1.0	11.3	366.3	8.4	26.9			32.6	12.9	8.3	257.1	17.2	50.3		41.8	62.5	21.5	20.3	186.7	1308.8
19	0.2	0.9		11.6					1.9	1.9	2.1	1.0	18.4	1.7	2.8	6.7	12.2		5.3	137.5	4.3	5.2			16.5	7.5	3.5	257.3	8.9	10.4		41.3	62.3	22.0	12.9	75.5	761.3
20				4.9					1.7	1.1	1.4		18.5	0.9	3.3	2.7	6.6			96.1		1.6			5.1	2.4		256.3	2.3	4.3		40.2	61.7	22.0	7.7	52.4	619.4
21				1.4					1.6				18.4	0.3	4.9		2.4			71.4					2.5			256.0				38.9	61.2	21.7	3.9	36.6	548.6
22													18.4		7.3					55.5								252.8				36.6	60.0	21.1	1.5	24.3	510.5
23													6.7		9.6					43.2					2.3			251.9				34.6	59.5	20.1	0.8	15.2	467.8
24													3.3		9.8					33.4					3.2			247.3				32.3	58.4	18.5	1.2	7.0	437.3

TABLE 1A

MARCH

DAY HOUR	BUILDING TYPE																																				
	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1							3.6	6.2					3.4		3.1					31.7			3.4					56.9				15.7	13.6	9.4	1.1	12.0	169.7
2							3.5	6.4					2.1		6.6					24.6			1.5		1.4			4.1				8.3	9.4	6.0		5.7	94.9
3							3.8	6.5					1.0		9.3					18.4					2.3			30.4				2.7	5.4	2.6	0.8		102.8
4							3.3	6.6					0.2		11.4					13.3					3.0			19.7					2.4		1.1		84.0
5							3.2	6.3							12.4					8.7					3.7			11.3							1.3		71.7
6							2.5	6.2							11.3					5.0					4.4			3.4									55.4
7							3.2	6.4							8.3																			3.2			37.7
8							4.4	7.6							7.2					205.2					4.2	2.4							38.4	11.9			295.7
9							10.9	12.9						3.3	6.8	47.3	68.1		3.7	237.8	27.1				19.0	98.6		191.1					50.3	13.3		48.1	856.2
10		4.0					12.5	14.2						4.1	5.5	62.7	91.4		56.5	259.7	50.0	1.1			49.9	109.5		214.7		21.1			54.0	14.9	25.4	129.8	1204.1
11	3.2	6.3			4.1	1.2	14.4	16.5	3.4			4.0	3.6	4.9	4.6	74.9	106.7	0.9	69.6	276.7	55.9	20.5			114.1	121.6	3.3	229.3		41.6	16.4	13.5	58.3	17.6	44.7	155.1	1540.5
12	4.8	9.8			5.1	4.1	2.4	4.8	2.7			12.2	17.1	5.5	1.7	85.1	120.0	4.6	81.5	305.9	61.4	26.5			145.7	133.6	40.5	243.4		50.6	20.1	36.8	61.2	20.4	55.1	176.2	1833.4
13	7.6	11.6	2.2	14.6	5.9	4.8	2.6	4.4	3.9	0.8		14.6	17.1	6.1		97.7	130.0	5.2	93.1	375.2	66.9	31.7			156.3	145.9	48.7	257.1	51.4	61.6	23.2	44.1	64.3	23.9	60.6	196.5	2146.4
14	8.8	13.2	8.7	30.2	6.7	5.5	2.8	4.8	6.3	5.9	5.7	16.9	18.7	6.7		107.0	144.1	5.7	100.3	400.9	72.1	36.6			169.3	156.9	56.6	269.7	70.5	71.5	26.1	51.2	67.3	26.8	66.2	213.3	2365.4
15	9.4	14.2	8.9	25.0	7.4	6.1	2.7	4.5	8.4	4.4	4.1	18.0	19.6	7.1		112.9	149.8	6.0	108.4	418.3	75.3	39.6		3.7	174.6	162.6	61.2	276.8	76.2	76.8	28.8	54.7	70.0	29.6	70.0	223.1	2496.5
16	9.6	14.9	8.9	27.1	8.0	6.6	3.2	4.9	7.4	4.7	4.6	19.1	20.4	7.4	2.1	45.1	61.8	6.2	46.9	409.7	78.1	42.3		6.9	79.5	39.9	65.0	283.1	82.3	81.1	8.8	58.4	72.4	31.9	73.5	230.1	2101.3
17	9.6	14.9	8.1	39.1	8.3	6.9	2.9	4.5	6.9	5.0	4.8	19.5	20.9	7.6	8.0	32.2	45.7	6.3	34.7	416.3	80.3	43.9		7.6	70.5	34.3	67.5	287.6	86.7	83.9	8.0	61.2	73.9	33.7	75.7	233.9	2112.8
18	8.9	14.2	6.7	40.9	8.3	7.0	1.6	3.0	7.9	6.8	6.6	9.0	21.1	7.7	8.9	24.0	35.1	2.3	26.5	419.8	19.9	43.7		7.9	58.0	28.7	20.9	289.6	38.7	84.2	7.5	62.1	75.2	35.1	30.4	233.6	1846.6
19	2.6	3.5	1.1	19.5	1.5	1.3	0.8	2.0	7.9	5.6	5.4	6.4	21.1	3.1	7.6	17.8	25.6	1.6	18.7	175.3	15.9	13.6	3.3	3.7	436.1	23.3	16.7	291.7	29.7	28.1	5.9	62.4	75.3	36.2	22.6	94.0	1556.9
20	1.3	2.0		10.6	0.8	0.5		0.9	8.8	4.5	4.3	4.1	21.2	2.3	7.0	13.5	19.5	1.1	13.9	133.2	11.9	10.3	14.5	2.7	31.5	17.9	12.4	293.5	22.4	21.2	4.3	61.6	75.2	36.6	17.0	67.7	1002.4
21	0.4	1.0		5.7	0.2	0.1			6.4	1.9	1.6	2.3	21.3	1.6	4.3	10.9	14.9	0.7	10.4	102.5	8.7	7.0	11.7	1.6	21.1	13.4	8.2	293.1	16.9	14.7	3.0	60.7	74.8	36.3	12.4	50.7	859.2
22		0.2		3.2					3.6	0.9	0.7	0.8	21.1	1.0	2.8	8.2	10.4	0.3	6.7	77.7	5.0	4.1	7.4	0.8	11.9	8.4	5.2	289.6	10.9	10.0	1.3	58.2	73.5	35.3	9.0	38.4	735.8
23				1.1					1.7				7.6	0.6	1.1	5.4	6.6		3.5	57.9	1.8	1.6	1.3		2.7	4.2	1.9	284.1	5.8	5.2		55.3	71.8	33.7	5.9	28.0	599.2
24													5.1	0.2	1.2	2.9	2.6			40.3			7.2					276.3	1.4			51.3	69.7	31.3	2.9	19.4	519.5

APRIL

DAY HOUR	BUILDING TYPE																																				
	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1							11.5	12.4	1.2	0.4	0.3		4.6	0.7	4.6	7.0	8.0		5.9	48.7	3.2	2.7	8.0	0.7	4.4	6.2	3.3	68.0	8.9	5.9	2.3	26.4	19.6	15.0	6.2	21.3	321.9
2							12.2	12.8	0.4				3.3	0.3	3.1	5.3	5.0		3.3	35.4	0.9		5.5			2.2	0.9	52.4	5.0	2.6	0.7	18.5	14.7	11.2	3.7	15.6	224.8
3							11.9	13.2					2.4		1.9	3.0	2.1			23.0			3.7					40.6				12.8	11.1	7.7	2.0	10.4	152.0
4							11.8	12.8					1.6		0.6					17.9			1.8					29.8				7.0	7.5	5.1	0.7	5.5	104.9
5							11.2	12.9					0.7							13.3					1.5			21.4				2.6	4.9	2.9			72.1
6							11.0	12.4					0.2		0.6					9.5					2.0			14.2					2.6	0.4	0.6		54.9
7							11.2	12.7						1.7	1.7					6.2		1.6			2.3			8.7		12.7			0.7	18.7	0.8		84.1
8							12.0	13.5						4.0	1.7	46.9	60.6		27.6	211.6	26.6	18.4			20.3	79.7		4.1		42.2	1.8		54.5	21.3	0.9		653.1
9	0.7	5.2					15.9	16.7	1.6					4.7		77.5	103.3		69.7	286.3	56.3	20.0			85.7	123.2		220.3		49.0	16.8	15.4	59.3	23.1	23.0	117.0	1409.3
10	5.1	10.7			3.6	1.9	17.8	18.3	6.3	0.6	1.0	2.9		5.4		91.1	119.4	3.6	84.2	325.2	60.7	26.1			126.1	133.4	38.6	237.9	30.5	56.5	21.9	34.2	63.9	25.3	50.8	165.6	1831.2
11	9.1	13.6			6.4	5.4	19.7	20.1	6.3	3.9	3.5	13.5	12.6	6.1		107.3	137.8	5.1	100.9	358.2	66.4	33.8		3.9	144.9	147.7	52.0	255.1	62.6	68.3	27.7	43.1	67.8	28.2	60.5	195.6	2208.3
12	10.9	16.0	10.5	13.6	7.4	6.2	8.2	9.2	8.5	6.6	6.2	16.2	17.4	6.7	0.7	119.7	152.0	5.8	113.6	390.7	71.6	40.4		5.5	160.7	160.2	60.9	270.0	76.0	79.2	32.4	51.0	71.6	31.6	67.1	219.1	2470.0
13	12.3	17.8	12.1	38.8	8.3	6.9	8.1	9.1	12.8	7.2	6.6	19.4	19.1	7.2	8.2	128.8	162.8	6.3	123.5	420.4	77.2	46.2		6.6	171.4	170.9	68.9	282.6	87.9	88.7	35.3	58.4	74.2	34.5	72.8	236.4	2727.0
14	13.9	20.1	13.1	53.1	9.5	7.6	8.9	9.3	17.3	8.5	7.8	22.4	20.7	7.8	11.6	141.1	175.8	8.7	135.7	450.2	82.2	53.6		8.1	183.0	182.5	77.9	295.2	101.2	99.9	40.3	65.5	77.8	38.3	78.5	254.9	2989.7
15	14.9	21.4	13.6	42.8	10.7	8.3	9.3	9.5	13.3	7.2	6.8	24.7	21.9	8.3	15.5	147.1	183.3	12.4	142.3	475.0	86.6	57.5		9.6	194.7	191.5	84.2	305.6	111.2	107.5	43.8	71.5	80.9	41.4	83.2	267.4	3157.1
16	14.7	21.5	13.1	38.7	10.9	8.9	8.6	9.1	10.5	7.1	6.8	24.6	22.5	8.6	16.8	55.3	73.1	13.0	58.3	452.3	88.2	59.0		10.6	96.9	51.4	87.0	310.1	114.7	109.4	14.7	73.7	82.8	42.9	85.8	271.4	2609.6
17	14.4	21.4	12.1	55.6	11.2	9.2	8.3	8.7	9.4	7.4	7.2	25.2	22.9	8.8	19.8	41.0	54.9	13.1	44.0	463.0	90.5	59.8		11.3	85.8	44.1	88.5	313.4	117.6	111.9	14.0	75.7	84.3	44.5	87.9	74.1	2403.6
18	13.7	20.7	10.6	57.9	11.2	9.2	8.6	9.0	17.7	9.6	9.1	12.2	23.0	8.8	20.6	32.5	43.5	6.6	35.1	466.7	27.8	59.8	24.7	11.5	76.3	38.2	30.3	315.3	54.1	112.1	13.1	76.7	85.1	45.7	37.8	273.3	2328.2
19	5.3	6.1	4.3	25.0	3.3	3.1	8.0	7.8	18.4	8.8	8.2	9.7	23.1	4.1	19.4	25.4	35.1	5.3	28.3	203.6	23.4	19.4	37.6	6.5	62.9	33.2	24.8	316.0	44.3	39.5	11.8	77.0	85.0	48.2	29.7	107.4	1542.9
20	3.6	4.3	2.3	14.9	2.4	2.2	6.2	6.4	16.6	7.4	6.8	7.5	23.2	3.2	18.4	21.0	27.5	4.4	22.0	159.9	19.2	15.6	39.8	5.7	49.5	27.5	19.7	316.8	35.1	31.4	10.3	76.1	85.0	46.4	23.2	77.0	1344.8
21	2.4	2.9	1.0	9.5	1.6	1.7	6.1	5.4	10.0	4.1	3.8	5.5	23.2	2.5	12.3	17.6	22.7	3.3	18.2	127.9	15.6	12.4	42.5	4.5	38.2	22.8	15.9	319.0	29.0	24.7	8.3	75.6	84.5	46.8	18.7	59.4	1179.3
22	1.6	2.1		5.9	1.2	1.2	3.5	4.0	6.1	2.9	2.7	4.0	23.2	1.9	10.2	14.9	18.2	2.6	14.5	102.7	12.8	9.5	38.7	3.6	28.6	17.6	12.1	316.5	22.9	18.8	6.6	73.4	83.8	46.2	14.7	46.2	1042.3
23	0.9	1.2		3.5	0.8	0.7	1.4	2.6	3.7	1.9	1.8	2.7	8.9	1.5	8.3	12.3	14.7	1.9	11.6	81.9	9.4	6.8	30.6	2.6	20.5	13.3	8.7	309.9	17.4	13.7	4.9	70.0	81.7	43.8	11.4	36.6	883.5
24	0.2	0.4		1.8	0.4	0.4		1.0	2.3	1.1	1.0	1.2	6.3	1.0	6.4	9.8	10.7	0.9	8.2	64.6	6.5	4.6	13.5	1.7	11.8	9.4	5.7	302.8	12.8	9.5	3.5	66.5	78.9	41.7	8.7	28.3	748.4

TABLE 1A

MAY

DAY HOUR	BUILDING TYPE 1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12
1	1.2	1.4		2.9	1.3	1.2	18.6	16.9	2.7	1.9	1.8	3.2	5.6	1.4	11.1	13.7	14.9	3.0
2	0.5	0.7		1.2	0.9	0.9	19.6	18.1	1.6	1.0	0.9	2.0	4.4	1.1	9.5	11.7	11.8	2.3
3	0.3	0.3			0.6	0.5	18.7	18.0	0.9	0.4	0.4	0.8	3.5	0.8	7.9	9.4	8.9	1.4
4					0.2	0.1	18.5	17.5	0.3				2.5	0.5	6.5	7.5	6.4	0.8
5							16.9	17.0					1.9	0.2	4.6	5.0	4.2	
6							16.2	16.1					1.2		3.3	3.6	1.6	
7	0.4						17.1	17.1					0.9	3.9	2.5	3.5	2.1	
8	5.1	6.7					17.6	17.8	1.6	2.7	2.8		0.7	4.8	1.5	68.1	88.4	
9	7.1	11.8			4.4	3.3	21.7	21.3	4.2	4.1	3.8	6.0	0.9	5.6	2.9	91.4	116.0	3.7
10	9.4	14.2	6.9		6.8	5.6	23.5	22.8	8.7	4.2	3.9	13.2	1.2	6.3	4.8	107.0	135.8	4.9
11	11.5	16.8	10.1	8.5	8.0	6.6	25.6	24.8	8.4	5.3	4.9	16.5	14.8	6.9	8.1	121.1	151.4	8.2
12	13.5	19.4	12.6	40.2	9.1	7.5	12.9	13.1	14.5	7.9	7.3	19.7	18.5	7.5	12.1	134.6	166.6	11.8
13	15.8	22.6	14.9	56.7	10.4	8.4	13.3	13.3	20.6	8.9	8.2	22.8	20.7	8.2	16.5	151.0	183.2	14.8
14	18.1	25.6	16.7	65.3	12.0	9.3	14.0	13.5	25.8	10.5	9.5	26.7	22.3	8.8	21.0	166.2	199.6	17.6
15	19.1	27.0	17.7	50.4	13.1	10.4	14.5	13.8	15.1	8.6	8.1	29.2	23.6	9.4	25.5	174.0	206.7	20.0
16	19.3	27.4	17.5	47.0	13.6	11.0	13.9	13.4	12.0	8.6	8.4	29.7	24.2	9.6	28.2	63.0	81.6	21.1
17	18.9	27.2	16.6	69.5	13.9	11.3	13.5	13.0	10.2	8.8	8.7	30.4	24.7	9.8	30.0	47.9	62.6	21.2
18	18.7	27.5	15.3	74.7	14.0	11.3	17.5	15.5	26.3	11.8	11.1	15.3	25.1	10.0	30.7	38.7	52.3	9.6
19	7.7	8.4	7.6	30.5	4.6	4.6	16.4	14.5	28.4	11.6	10.5	13.3	25.1	5.0	30.5	32.2	43.3	8.3
20	5.5	6.2	5.0	19.4	3.8	3.7	14.5	12.5	29.5	10.1	9.0	10.6	25.2	3.9	29.3	26.8	35.8	7.2
21	4.2	4.8	3.5	12.6	3.2	3.0	15.1	12.1	11.4	6.0	5.6	8.7	25.5	3.3	20.2	23.8	30.0	6.4
22	3.3	3.8	2.5	9.3	2.6	2.5	13.9	11.4	6.5	4.5	4.3	7.1	25.4	2.7	17.2	21.1	26.3	5.5
23	2.6	3.0	1.5	6.9	2.2	2.1	10.3	9.4	4.6	3.5	3.3	6.7	10.2	2.3	15.3	18.3	22.5	4.6
24	1.8	2.1	0.6	4.7	1.7	1.6	7.9	6.9	3.6	2.6	2.5	4.2	7.5	1.9	13.3	16.5	18.5	3.9

DAY HOUR	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	12.8	69.2	10.7	7.3	12.0	3.6	19.2	15.1	10.5	78.1	19.9	15.0	6.6	36.1	24.4	20.4	11.4	28.7	550.4
2	10.0	55.9	8.4	5.5	8.8	2.5	12.5	11.1	8.2	62.0	16.1	11.7	5.4	27.8	19.8	16.2	6.9	22.7	436.2
3	7.5	42.8	6.3	3.4	6.7	1.6	7.4	8.2	5.3	49.5	11.6	7.9	3.9	21.7	15.6	12.5	6.9	17.2	334.2
4	5.3	30.6	3.5	1.9	4.7	0.9	1.4	4.7	3.3	38.4	8.3	5.2	2.4	15.6	11.9	9.8	4.6	12.4	242.7
5	3.3	22.0	1.8		3.5			1.6	0.9	29.1	4.4	1.9	1.5	10.5	9.2	7.1	3.1	9.1	170.1
6		13.1			2.1					21.9	1.8			6.7	6.5	5.2	1.4	5.6	114.1
7	1.4	9.9		20.5	1.0	2.2				16.8		45.0		4.3	5.4	24.0	1.0	5.3	196.1
8	60.1	262.8	54.5	25.9		3.1	81.0	117.3		12.8		57.0	19.6	2.5	59.8	26.8	0.8	7.7	1056.9
9	83.1	311.0	61.7	30.9		3.7	114.9	135.2	35.5	232.8	39.3	65.9	23.7	35.1	64.0	29.5	44.9	137.8	1844.9
10	100.8	350.6	66.8	35.1		5.0	136.2	148.9	53.5	253.3	62.5	72.5	29.5	43.5	68.8	31.5	58.0	185.7	2205.2
11	114.9	387.0	72.5	42.1		6.4	156.5	160.9	62.7	268.7	78.4	82.7	33.9	51.6	73.2	34.3	66.6	213.4	2530.2
12	128.7	420.0	79.0	48.9		7.9	171.3	173.8	72.5	283.7	93.2	94.4	38.7	60.5	76.8	38.1	74.0	236.3	2829.6
13	144.6	452.5	84.4	57.0	1.5	9.5	184.3	186.0	82.8	299.1	108.2	107.3	44.3	68.9	80.9	42.5	80.7	261.9	3149.2
14	160.1	486.7	90.6	65.5	2.7	11.1	196.5	201.9	94.3	314.7	125.3	121.8	50.1	76.9	85.4	47.4	88.4	287.0	3466.6
15	168.3	513.7	96.5	70.7	3.6	12.4	208.7	211.7	101.2	326.1	136.4	130.0	54.8	84.1	89.7	50.7	94.0	301.3	3645.6
16	66.8	493.6	99.8	72.1	4.7	13.8	110.7	80.3	104.7	331.8	142.3	134.0	18.7	88.2	91.8	53.0	96.6	306.7	3053.4
17	51.8	505.1	101.3	74.0	5.3	14.5	110.5	82.7	106.4	335.4	145.3	135.6	18.3	90.3	93.2	54.5	99.1	306.6	3057.7
18	43.6	512.0	34.8	75.6	59.8	15.1	91.1	47.2	37.1	340.8	65.5	140.1	17.6	92.7	94.8	56.2	43.7	313.9	2799.7
19	36.4	225.3	31.2	24.8	64.6	9.2	79.2	42.4	31.4	342.5	53.9	50.3	16.6	93.5	95.4	57.2	34.7	119.8	1888.5
20	30.2	181.0	26.9	21.2	75.4	8.1	65.0	36.6	26.7	345.2	45.8	39.7	14.8	92.7	951.0	58.5	28.8	86.7	2545.1
21	25.4	149.0	23.4	17.7	85.1	7.1	53.5	31.9	23.1	351.4	39.9	33.7	13.2	93.4	96.2	60.2	24.0	67.4	1515.9
22	22.5	123.8	19.6	14.8	75.9	6.3	43.6	27.0	19.3	345.9	34.0	27.9	11.4	90.5	94.2	58.6	20.0	54.6	1364.2
23	19.4	103.0	17.1	12.1	64.7	5.2	35.7	22.4	15.9	337.0	28.6	22.9	9.8	85.9	91.2	55.1	16.7	44.1	1191.9
24	16.0	85.7	14.2	9.9	18.7	4.1	26.9	18.6	13.1	329.5	24.0	18.8	8.4	81.7	88.6	52.6	13.9	36.0	1023.0

JUNE

DAY HOUR	BUILDING TYPE 1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12
1	2.6	2.8	1.8	5.5	2.3	2.3	29.2	25.8	3.8	3.1	3.0	5.6	6.7	2.1	17.0	19.3	21.6	5.3
2	2.0	2.2	1.0	3.9	1.8	1.9	29.3	25.5	3.0	2.4	2.4	4.6	5.4	1.7	15.3	17.3	18.4	4.5
3	1.4	1.6	0.4	2.6	1.5	1.5	28.1	25.4	2.1	1.6	1.6	3.5	4.3	1.4	13.8	15.2	15.7	3.8
4	0.9	1.1		1.1	1.2	1.2	27.8	24.7	1.7	1.3	1.3	2.7	3.5	1.1	12.3	13.3	13.3	3.2
5	0.6	0.6			0.8	0.8	26.2	24.2	1.1	0.8	0.8	1.7	2.9	0.9	11.0	10.8	11.1	2.4
6	0.4	0.4			0.6	0.6	26.2	24.1	0.6	0.4	0.4	1.4	2.2	0.6	9.3	9.4	9.2	1.9
7	7.7	3.7	1.9	1.3	0.5	0.4	28.5	25.8	7.2	3.5	3.3	1.9	1.9	4.9	8.5	9.1	9.4	2.1
8	12.0	18.2	6.7	4.9	0.8	0.7	30.0	27.3	15.2	5.6	4.9	2.8	1.9	6.2	8.1	109.0	121.6	3.1
9	14.4	22.0	10.2	9.9	7.8	6.4	28.8	26.7	21.3	7.7	6.6	14.9	2.2	7.1	13.3	144.2	167.7	9.8
10	17.0	24.3	13.5	14.5	10.6	7.5	29.0	27.4	11.9	6.7	6.1	20.9	2.5	7.8	18.5	157.3	183.4	15.5
11	19.1	27.2	16.1	17.4	12.2	9.3	30.7	29.1	8.6	7.0	6.7	26.0	17.1	8.5	22.6	170.9	199.4	20.3
12	20.8	29.1	18.2	63.6	13.2	10.4	18.2	17.3	28.3	10.8	9.9	28.2	21.5	9.0	27.0	182.9	213.2	23.9
13	22.2	31.3	19.9	80.4	14.2	11.1	18.5	17.5	34.8	12.2	10.8	30.9	23.1	9.6	31.0	193.7	225.0	27.2
14	24.2	33.8	21.6	85.8	15.5	12.3	18.7	17.6	39.3	13.6	12.1	33.8	24.8	10.2	35.7	207.4	239.6	31.5
15	25.9	36.2	22.8	63.2	16.8	13.3	19.3	18.2	16.1	10.7	10.2	37.0	26.0	10.8	40.2	219.2	252.2	35.2
16	25.2	35.3	22.2	58.1	17.1	13.5	18.6	17.3	11.3	9.9	9.7	36.6	26.5	10.9	41.3	73.5	93.6	34.0
17	25.4	36.1	21.4	91.8	17.5	13.8	18.2	16.8	11.2	10.0	10.0	37.7	27.1	11.2	43.1	55.2	71.6	36.3
18	24.8	35.5	20.0	95.0	17.5	13.8	23.9	20.6	40.4	13.9	12.8	18.2	27.3	11.3	43.8	45.7	59.9	13.4
19	9.7	10.5	10.7	32.1	6.1	5.8	27.9	23.2	43.2	14.5	12.8	16.0	27.4	5.9	43.5	39.1	51.0	11.3
20	7.2	7.8	7.3	19.5	5.0	4.9	25.2	20.3	40.3	12.6	11.0	13.6	27.3	4.7	40.5	33.2	43.0	9.7
21	5.7	6.3	5.5	14.9	4.2	4.1	24.1	19.4	13.8	7.6	7.1	11.5	27.3	4.0	27.4	29.4	38.8	8.7
22	4.8	5.2	4.3	11.8	3.6	3.5	22.7	18.4	7.6	5.8	5.7	9.8	27.3	3.3	23.4	26.7	33.1	7.8
23	4.0	4.4	3.5	9.4	3.2	3.1	20.4	16.6	5.9	4.7	4.6	8.1	11.3	2.9	21.2	24.5	29.2	7.0
24	3.3	3.6	2.6	7.2	2.7	2.7	16.9	14.4	4.8	3.9	3.8	7.0	8.4	2.4	19.1	22.1	25.2	6.2

DAY HOUR	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	19.5	86.5	17.2	11.8	13.1	5.5	32.4	21.8	16.6	86.9	29.3	22.8	10.2	44.5	29.1	25.6	15.5	35.6	760.6
2	16.7	71.5	14.8	10.0	10.7	4.7	25.3	18.6	13.5	70.4	24.5	19.6	8.6	36.0	24.0	20.2	13.2	29.3	639.2
3	14.3	60.0	11.9	7.8	8.9	3.7	19.2	14.9	11.4	56.7	21.0	15.7	7.5	28.8	19.5	16.7	11.4	23.9	532.6
4	12.2	47.9	9.9	6.3	7.1	3.1	14.5	12.2	9.5	46.2	16.7	13.0	6.0	23.4	15.8	13.9	9.1	20.1	442.8
5	10.1	39.2	8.2	4.5	5.9	2.2	10.8	9.9	7.0	37.6	13.8	9.7	5.1	19.0	13.1	11.2	7.6	16.1	363.4
6	8.5	31.1	5.8	3.3	4.5	1.7	7.3	6.9	5.4	29.5	11.2	7.6	3.8	14.3	10.3	9.3	5.9	13.5	295.3
7	8.8	28.1	5.1	35.3	3.6	5.5	11.3	6.0	4.8	24.6	10.1	76.0	3.9	12.1	9.2	34.2	5.7	13.3	493.7
8	94.9	299.4	67.4	52.0	2.8	6.3	114.2	146.0	4.9	21.4	9.2	101.1	30.3	11.2	68.7	41.6	6.2	18.4	1601.0
9	134.7	376.5	76.2	54.3	2.5	7.1	137.9	176.9	65.5	261.7	76.6	106.8	44.0	50.2	77.7	44.0	57.9	186.9	2647.8
10	149.6	426.4	84.1	61.8	2.6	9.1	163.6	188.2	88.8	296.9	112.8	117.4	48.0	64.5	82.9	47.6	76.8	255.5	3083.3
11	163.4	459.8	90.2	67.7	3.1	11.4	181.8	200.6	95.4	308.0	126.4	127.2	53.4	74.3	86.9	50.6	85.1	277.1	3396.2
12	176.0	490.7	95.9	73.5	3.9	13.3	194.8	211.9	104.4	322.4	139.2	137.2	57.7	82.3	90.9	54.4	91.7	300.5	3705.8
13	186.7	516.3	101.9	79.5	4.7	14.7	206.4	223.1	112.6	334.9	151.9	147.2	61.2	90.2	93.8	57.7	97.8	317.7	3960.3
14	200.6	548.7	107.4	87.3	5.6	16.7	217.5	236.3	123.0	349.4	166.0	159.0	67.4	98.4	98.4	62.3	104.3	340.8	4251.5
15	212.4	579.1	113.3	84.4	6.7	18.3	230.6	247.6	131.5	362.1	180.3	170.7	72.4	104.9	102.6	66.7	110.9	356.9	4444.6
16	78.8	551.0	114.6	93.1	7.5	19.0	126.8	71.3	131.1	364.1	180.6	169.2	23.0	107.0	103.4	67.1	111.8	358.0	3646.2
17	60.6	569.1	116.1	96.4	8.1	19.6	114.8	61.8	136.0	369.1	186.7	174.1	22.6	109.5	105.4	69.3	114.5	364.4	3676.6
18	51.5	566.1	43.3	96.1	98.6	20.0	105.6	55.6	46.4	372.9	79.8	175.4	21.8	111.1	106.5	70.1	50.5	364.9	3356.6
19	44.1	248.1	38.6	29.8	105.5	11.6	94.8	50.8	38.5	372.5	64.6	60.9	20.7	111.3	106.1	70.0	40.4	131.0	2258.7
20	37.3	200.3	34.0	26.0	108.7	10.5	78.3	4.9	33.5	372.3	56.1	48.3	18.7	108.6	105.1	69.9	33.6	94.8	1971.9
21	32.2	167.9	30.4	22.5	111.3	9.5	66.0	40.1	29.7	375.4	50.0	42.0	17.1	107.8	104.4	70.4	28.9	74.4	[illegible]
22	29.3	142.3	26.4	19.4	111.3	8.3	56.0	34.9	25.7	373.3	43.7	36.0	15.2	105.2	103.2	69.6	24.7	61.4	[illegible]
23	26.1	121.1	22.9	16.7	111.3	7.3	47.6	30.3	22.2	366.3	38.3	30.9	13.5	101.7	101.0	67.6	21.3	51.0	[illegible]
24	22.7	101.5	19.9	13.8	22.1	6.3	39.1	26.2	19.2	358.5	33.5	26.6	12.0	97.4	98.4	64.4	18.4	43.1	1270.7

TABLE 1A

JULY

DAY HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12
1	2.1	2.4	1.2	4.6	1.8	1.7	28.0	25.1	3.1	2.4	2.3	4.7	6.4	1.8	15.0	17.6	19.5	4.5
2	1.6	1.6	0.7	3.1	1.4	1.4	28.4	24.8	2.6	2.0	2.0	3.8	5.0	1.4	13.5	15.3	16.6	3.7
3	1.1	1.3		2.1	1.2	1.1	27.9	24.7	2.0	1.5	1.4	3.0	4.1	1.2	12.2	13.4	14.1	3.1
4	0.8	0.9		0.9	0.9	0.9	27.6	24.4	1.4	1.0	0.9	2.3	3.3	1.0	10.8	11.4	11.7	2.6
5	0.4	0.5		0.4	0.7	0.6	27.3	24.3	1.1	0.8	0.8	1.6	2.7	0.7	9.5	9.8	9.7	1.9
6	0.3	0.3			0.4	0.4	27.3	24.3	0.6	0.3	0.3	1.0	2.1	0.5	8.3	7.7	7.9	1.5
7	7.9	3.8	1.8	1.5	0.3	0.3	29.1	26.1	8.6	3.3	3.1	1.6	1.8	4.9	7.3	7.7	8.2	1.7
8	13.3	20.3	6.6	4.8	0.5	0.5	31.4	28.2	18.4	5.7	4.8	2.5	1.7	6.2	8.8	118.1	126.9	2.6
9	15.5	24.0	10.3	10.1	7.7	6.2	28.7	27.2	24.5	8.0	6.7	14.7	2.0	7.1	13.4	154.9	178.1	11.2
10	18.1	26.2	14.0	14.6	11.4	7.8	28.8	27.1	11.9	6.7	6.2	22.8	2.3	7.9	18.4	166.7	191.5	18.6
11	20.2	29.0	16.6	18.2	12.4	9.7	29.8	28.4	8.6	7.0	6.8	26.5	17.1	8.5	23.4	180.3	207.9	22.5
12	22.6	31.7	18.9	70.4	13.9	10.7	17.6	16.7	33.3	10.8	9.8	29.4	21.8	9.1	27.7	195.8	223.6	27.7
13	23.7	33.6	20.7	86.3	14.8	11.5	17.6	16.3	39.5	12.4	10.7	31.9	23.4	9.7	31.3	206.0	235.4	30.5
14	24.5	34.6	21.6	88.7	15.5	12.1	17.3	16.5	40.1	13.3	11.6	33.4	24.9	10.2	34.6	211.9	242.8	32.3
15	25.0	35.3	21.9	62.3	16.5	12.9	17.3	16.4	16.2	10.1	9.6	35.2	25.8	10.6	38.1	216.9	248.3	33.6
16	24.8	35.2	21.2	67.4	16.7	13.1	16.4	15.6	10.4	9.0	8.9	35.6	26.4	10.8	40.1	72.4	92.5	33.9
17	24.1	34.7	20.1	88.4	16.7	13.2	15.4	14.9	10.1	9.0	8.9	35.4	26.7	10.9	40.9	53.6	69.6	33.6
18	23.6	34.1	18.4	91.1	16.7	13.2	20.1	17.6	37.8	12.8	11.8	18.6	26.8	11.0	42.1	44.7	57.0	12.7
19	8.7	9.6	9.5	30.2	5.4	5.2	24.1	19.8	42.1	13.2	11.4	14.4	26.9	5.5	41.0	37.4	48.0	10.0
20	6.3	6.9	6.2	17.5	4.3	4.3	23.4	19.4	37.9	11.7	10.2	11.7	26.8	4.4	39.3	31.8	40.3	8.5
21	5.0	5.5	4.5	12.9	3.7	3.5	21.2	18.2	12.9	6.6	6.1	9.7	26.8	3.6	28.1	28.1	34.4	7.6
22	5.1	4.6	3.4	9.8	3.0	3.0	19.7	18.1	7.0	5.1	4.9	8.5	26.6	3.0	21.9	25.5	30.7	6.7
23	3.4	3.7	2.6	7.7	2.6	2.5	16.9	14.0	5.3	4.0	3.9	6.8	10.9	2.6	19.0	22.6	26.2	5.9
24	2.7	3.0	1.9	5.9	2.2	2.1	14.1	12.2	4.1	3.2	3.1	5.7	8.1	2.1	17.4	20.4	23.2	5.2

DAY HOUR	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	17.5	78.2	14.2	10.3	12.0	4.4	27.9	19.1	13.7	84.7	24.9	19.2	8.6	42.2	28.0	24.0	13.9	33.5	686.6
2	14.9	65.5	12.0	8.6	9.6	3.7	21.3	16.2	11.6	68.1	21.4	16.2	7.4	33.7	22.3	19.0	11.8	28.0	575.7
3	12.7	54.1	9.9	6.4	7.8	3.0	16.3	12.4	9.5	54.4	18.0	13.3	6.3	26.4	18.4	15.0	9.6	23.1	478.1
4	10.6	44.4	8.0	5.0	6.4	2.4	12.2	10.0	7.7	44.1	15.0	10.7	4.9	21.2	14.7	12.3	8.0	18.6	397.3
5	8.8	35.8	6.3	3.7	4.9	1.9	8.5	7.7	6.0	35.3	12.2	8.4	4.0	16.8	12.0	10.1	6.5	15.6	327.4
6	7.1	27.8	4.7	3.0	3.8	1.3	5.1	5.6	4.4	28.3	9.6	6.2	3.2	13.0	9.7	8.1	5.2	13.1	267.0
7	7.6	24.4	4.0	38.2	3.0	5.1	9.4	4.7	3.7	23.2	8.4	78.6	3.2	10.7	8.5	34.9	4.8	12.2	475.9
8	99.9	301.4	67.2	57.2	2.3	6.0	112.8	161.3	3.9	20.3	7.7	108.8	33.6	10.0	69.9	43.2	5.4	14.7	1649.6
9	144.7	390.5	77.6	58.5	2.0	7.1	137.5	186.2	69.2	268.2	80.8	114.5	47.9	51.6	79.7	46.6	58.9	196.0	2767.5
10	157.4	434.1	85.4	66.9	2.3	10.1	162.4	194.3	94.6	304.7	120.7	124.6	50.7	66.2	84.6	49.3	79.7	270.0	3205.9
11	171.9	467.7	91.2	71.3	2.8	11.7	181.3	206.7	99.7	313.9	132.6	133.5	56.2	76.2	88.4	52.5	86.8	289.0	3506.1
12	186.4	499.4	97.0	79.2	3.5	13.6	194.8	219.9	110.7	330.5	147.8	146.1	61.4	84.4	92.6	56.7	94.3	316.4	3866.7
13	197.0	528.0	103.2	84.7	4.4	15.0	203.6	231.2	119.0	343.3	160.5	156.0	64.7	92.4	95.8	60.2	100.6	334.1	4115.7
14	203.7	549.0	107.3	88.2	5.3	16.3	214.6	238.3	124.2	351.9	166.7	161.8	67.5	97.8	98.8	63.2	104.6	345.3	4277.9
15	208.3	570.0	111.0	91.4	6.5	17.9	224.0	244.9	128.7	359.6	176.0	166.9	70.5	102.7	101.5	65.4	108.7	356.1	4363.6
16	77.8	547.6	114.4	92.6	7.3	18.5	119.2	69.8	132.3	364.7	180.6	169.9	21.6	106.0	103.4	68.1	111.3	359.5	3612.4
17	58.6	559.2	114.6	93.0	7.8	18.8	104.6	59.6	132.1	367.2	182.5	170.4	20.8	107.3	104.2	68.6	112.6	359.3	3572.1
18	48.6	558.3	41.6	92.6	93.6	18.9	96.2	53.5	44.7	369.1	77.6	170.9	20.1	108.5	104.8	69.0	48.6	357.9	3246.0
19	41.1	240.9	35.7	27.4	107.0	10.9	84.4	47.3	35.7	371.4	60.2	58.2	18.9	108.3	104.7	70.0	37.9	128.3	2162.3
20	34.7	192.2	31.0	23.2	104.8	9.6	70.0	41.4	30.6	370.1	52.9	44.9	16.9	106.2	103.9	69.1	31.1	91.4	1918.8
21	29.8	159.4	27.3	20.3	110.4	8.4	58.6	36.4	26.7	369.6	45.5	38.4	15.3	104.4	102.4	68.6	26.6	71.7	1699.1
22	26.9	134.2	23.5	17.3	101.6	7.3	49.0	31.5	22.9	364.7	39.5	32.6	13.5	100.7	100.5	66.2	22.5	58.3	1546.6
23	23.1	112.6	20.8	14.6	92.1	6.5	40.9	26.7	19.4	356.6	33.9	27.4	11.8	96.2	97.7	63.7	19.2	48.6	1366.0
24	20.6	95.4	17.9	12.3	20.7	5.3	34.0	22.8	16.5	352.8	29.3	23.2	10.4	93.1	96.0	61.8	16.4	40.7	1185.4

AUGUST

DAY HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12
1	2.4	2.6	1.5	5.0	1.8	1.8	30.6	26.4	3.4	2.7	2.7	5.1	6.5	1.9	16.2	19.0	21.3	4.8
2	1.8	2.0	0.8	3.7	1.5	1.4	28.9	25.7	2.7	2.1	2.1	4.2	5.3	1.6	14.5	16.7	18.4	4.0
3	1.3	1.5	0.2	2.5	1.2	1.1	28.9	25.2	2.3	1.8	1.7	3.4	4.2	1.3	12.9	14.6	15.7	3.4
4	0.8	0.9		1.1	0.9	0.9	27.4	24.9	1.7	1.3	1.2	2.3	3.4	1.0	11.6	12.7	12.5	2.8
5	0.5	0.5		0.6	0.6	0.6	27.2	24.6	1.1	0.8	0.8	1.7	2.8	0.8	10.2	10.4	10.5	2.2
6	0.4	0.4			0.4	0.4	26.4	24.2	0.6	0.3	0.3	1.0	2.2	0.6	8.7	8.8	8.4	1.6
7	6.9	3.1	0.7	1.0	0.3	0.2	26.3	24.3	5.9	2.9	2.7	1.2	1.8	4.8	7.5	8.0	7.7	1.5
8	11.2	17.8	5.2	2.6	0.4	0.3	28.5	25.6	13.9	5.0	4.3	1.7	1.6	6.0	7.3	109.5	119.6	2.2
9	13.6	21.6	8.8	7.8	7.2	5.9	27.4	25.9	20.3	7.0	5.9	13.2	1.7	6.9	12.0	144.2	166.9	8.2
10	15.6	22.9	12.3	13.3	10.0	6.9	27.4	26.4	12.2	6.3	5.6	19.2	2.1	7.5	16.3	152.0	178.7	12.9
11	17.9	25.7	15.1	17.3	11.4	8.7	29.1	27.7	8.5	6.8	6.5	24.9	16.6	8.2	20.0	163.8	192.6	17.3
12	20.3	28.6	17.5	60.4	12.5	9.8	16.1	15.5	27.4	10.2	9.3	27.5	21.2	8.8	24.6	180.4	209.9	22.5
13	22.4	31.7	19.6	80.8	13.9	10.8	16.1	15.5	36.3	11.9	10.4	30.9	23.1	9.4	29.0	196.7	227.1	27.1
14	23.8	33.2	21.1	87.6	14.9	11.6	16.4	15.7	38.5	13.1	11.5	33.3	24.6	10.0	33.8	205.7	237.3	30.2
15	25.2	35.5	21.6	62.9	16.2	12.5	16.9	16.0	15.9	10.2	9.7	35.5	25.8	10.6	38.0	216.4	249.1	33.7
16	25.2	35.7	21.5	60.1	16.6	13.0	16.4	15.8	11.2	9.8	9.6	36.8	26.5	10.9	40.3	72.6	93.5	34.5
17	24.8	35.5	20.2	91.6	16.8	13.2	16.0	15.3	10.7	9.6	9.5	37.0	26.9	11.0	42.0	54.4	70.5	3.4
18	24.7	35.9	18.7	96.9	17.1	13.3	21.4	18.2	42.1	13.6	12.5	17.4	27.2	11.2	43.5	44.5	57.9	12.9
19	8.8	9.4	9.2	30.7	5.3	6.0	25.4	20.4	44.4	13.9	12.0	14.8	27.2	5.7	42.2	37.4	48.9	10.0
20	6.4	7.0	6.1	17.5	4.2	4.1	24.7	20.2	41.7	12.1	10.4	12.5	27.1	4.4	40.6	33.0	41.2	8.8
21	5.2	5.7	4.8	13.4	3.6	3.4	23.2	18.9	13.7	7.2	6.6	10.5	27.2	3.7	27.3	29.6	36.3	8.0
22	4.4	4.8	3.8	10.6	3.1	3.0	21.7	18.1	7.2	5.4	5.2	8.9	27.1	3.2	22.7	26.3	31.8	7.0
23	3.6	4.0	3.0	8.5	2.6	2.6	19.0	15.8	5.6	4.3	4.2	7.6	11.1	2.7	19.8	23.5	28.0	6.2
24	3.0	3.3	2.1	6.7	2.2	2.2	16.6	13.3	4.4	3.5	3.4	6.5	8.2	2.3	18.3	21.2	24.2	5.5

DAY HOUR	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	19.3	82.8	16.1	11.0	12.7	5.0	30.0	20.2	15.4	85.9	26.4	21.4	9.1	43.4	28.5	24.6	14.7	34.6	728.3
2	16.7	68.1	13.7	9.2	9.9	4.2	23.4	17.1	12.4	69.0	22.6	17.2	7.9	34.7	22.8	19.5	12.5	28.3	605.5
3	14.3	56.5	10.8	7.0	8.1	3.3	18.3	13.3	10.3	55.3	19.2	14.3	6.8	27.3	18.8	16.0	10.6	23.9	507.1
4	11.4	46.6	8.9	5.6	6.7	2.7	14.2	10.9	8.5	45.0	16.2	11.7	5.4	22.1	15.1	13.3	8.6	19.4	420.0
5	9.6	36.2	7.2	4.3	5.4	2.1	10.5	8.6	6.8	36.4	12.3	9.4	4.5	17.7	12.4	10.5	7.1	16.1	345.6
6	7.7	29.0	5.6	3.2	4.2	1.6	7.1	6.7	5.3	29.4	9.8	7.4	3.3	14.1	10.2	8.7	5.6	12.6	282.8
7	7.1	23.2	4.4	34.6	3.2	5.2	6.7	5.0	4.0	23.6	7.8	74.6	2.8	11.0	8.1	34.1	4.8	11.6	444.0
8	92.5	293.7	65.8	51.8	2.4	5.7	107.8	145.1	3.3	19.4	6.8	99.9	30.6	9.2	68.1	41.2	4.8	12.8	1541.9
9	133.2	374.1	74.9	51.0	2.2	6.5	132.3	176.8	64.0	260.8	72.2	106.1	44.1	48.2	77.2	43.7	56.3	182.8	2589.1
10	144.9	414.0	81.2	57.8	2.0	8.3	158.0	183.1	84.2	292.8	106.0	111.5	45.5	60.8	80.8	45.2	74.5	248.7	2959.8
11	156.6	447.4	86.9	64.1	2.3	10.5	176.0	194.4	90.2	301.6	118.8	120.2	50.1	70.3	84.1	48.0	81.4	266.7	3253.0
12	172.5	480.2	94.0	72.1	3.0	12.4	190.7	209.8	102.4	320.1	136.0	133.8	55.8	80.1	88.7	52.3	89.6	295.5	3619.0
13	186.7	516.3	100.3	81.0	4.2	14.4	202.6	224.2	113.3	336.0	152.0	148.6	61.6	88.5	93.2	57.1	96.8	320.9	3957.9
14	198.2	543.8	106.2	86.3	5.1	15.9	214.7	234.6	121.2	348.1	164.4	158.0	65.1	86.2	96.5	61.0	102.6	337.2	4181.7
15	209.4	569.9	111.4	93.1	6.2	17.7	226.8	244.7	129.6	359.0	175.9	168.5	70.0	102.2	100.1	64.4	108.3	354.1	4366.8
16	78.8	552.9	114.0	94.6	7.3	18.4	124.0	71.7	133.0	366.5	183.1	172.3	22.4	106.7	103.0	67.3	111.7	360.4	3650.8
17	59.4	566.4	116.3	95.4	8.0	19.3	111.5	61.6	134.4	369.4	185.7	173.5	21.6	108.7	104.2	68.9	113.3	362.0	3571.7
18	49.5	570.3	43.5	98.2	104.4	19.8	100.2	54.8	45.6	375.1	78.9	178.5	20.7	111.2	106.0	71.0	4.2	368.4	3306.9
19	42.0	244.7	37.4	28.0	111.3	11.2	86.3	49.1	37.1	375.6	62.5	61.1	19.3	10.6	105.6	70.9	38.8	130.0	2107.1
20	35.5	195.2	32.8	24.4	111.3	9.9	7.7	43.3	32.2	375.3	54.1	47.1	17.3	108.8	104.9	70.6	32.2	92.3	1905.1
21	31.7	162.3	29.1	20.9	111.3	8.9	62.3	37.4	27.6	378.3	46.8	39.6	15.7	106.8	104.2	70.8	27.1	72.7	1748.0
22	28.0	136.4	25.2	17.9	111.3	7.8	53.0	32.2	24.4	373.3	41.6	34.5	13.9	104.0	102.7	69.9	23.0	60.2	1602.8
23	24.9	115.2	21.7	15.2	111.3	6.7	44.9	27.7	20.9	366.4	36.2	29.4	12.2	99.8	100.3	66.8	19.8	49.8	1439.7
24	21.6	97.8	18.8	13.0	26.1	5.8	36.1	23.8	18.1	358.8	31.7	25.2	10.8	95.6	97.6	63.9	17.0	41.8	1235.5

TABLE 1A

SEPTEMBER

DAY HOUR	BUILDING TYPE																																			
	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	1.2	1.4		3.0	1.0	0.9	22.5	19.3	2.4	1.7	1.6	3.6	5.8	1.5	11.8	14.7	16.3	2.9	14.2	66.6	12.0	7.6	10.7	3.2	20.3	14.2	10.7	78.2	20.0	15.4	6.1	35.9	24.3	20.9	11.3	29.4	560.6
2	0.6	0.8		1.6	0.7	0.6	22.4	20.7	1.7	1.1	1.0	2.3	4.6	1.1	10.3	12.4	13.3	2.2	11.6	54.1	8.9	5.9	8.2	2.5	13.8	11.2	8.5	62.6	15.4	12.3	4.6	28.3	19.1	16.5	9.1	23.4	450.0
3	0.3	0.3		0.8	0.3	0.3	21.6	19.6	1.0	0.5	0.5	1.5	3.5	0.8	8.7	10.2	10.6	1.4	9.3	41.5	6.9	4.3	6.1	1.9	8.8	7.7	6.5	49.3	12.1	9.5	3.5	21.4	15.3	12.8	7.3	17.9	351.3
4	0.1	0.1					20.5	19.5	0.4			0.4	2.7	0.6	6.9	8.3	7.4	0.9	6.3	31.5	5.0	2.3	4.7	1.0	3.3	5.2	3.9	39.1	9.1	6.0	2.2	16.3	11.7	10.1	5.1	14.1	263.8
5							19.7	18.4					2.0	0.3	5.7	6.1	5.4	0.3	4.5	23.4	2.6	1.1	3.6	0.5		3.1	2.3	30.8	5.4	3.8	1.3	12.1	9.1	8.0	3.6	10.4	197.5
6							19.0	18.0					1.4		4.3	4.6	3.6		2.8	15.3	0.9		2.2					22.7	2.7	1.6		7.4	6.8	5.6	1.9	6.9	137.7
7	1.3	0.1					18.8	17.9					0.9	4.0	3.1	3.2	1.9		1.3	10.1		23.4	1.3	2.7				16.8		54.8		4.2	4.4	27.2	1.0	4.7	220.9
8	5.6	7.9					19.9	19.2		2.4	2.3		0.6	5.1	2.4	81.8	95.5		67.5	265.7	58.1	30.8		3.2	79.9	124.2		12.7		73.6	19.3	2.5	60.7	31.5	0.6	5.8	1133.1
9	8.7	14.3			4.0	2.8	23.5	23.0	7.3	4.5	4.0	7.3	0.7	5.9	4.9	112.5	134.7	3.5	100.9	318.6	64.9	39.8		4.1	118.1	151.4	43.7	241.3	47.8	79.6	27.2	37.7	67.8	34.1	47.3	151.0	2041.8
10	11.3	17.8	6.4	5.3	8.9	5.4	25.2	24.9	10.0	4.2	3.7	14.1	1.1	6.6	8.2	125.5	153.2	4.9	118.3	369.5	72.7	44.9		5.3	143.2	163.2	66.9	269.9	78.5	89.9	35.2	48.8	72.4	36.6	63.6	210.9	2470.5
11	13.7	20.3	11.2	11.5	8.7	6.3	27.1	26.2	9.0	5.4	5.1	19.5	15.2	7.3	13.0	139.5	169.2	8.6	132.7	406.2	79.6	52.1		6.9	165.9	176.1	75.9	284.0	96.0	101.0	38.9	59.1	76.3	39.4	72.5	236.8	2814.5
12	15.7	22.7	13.5	47.6	9.9	7.5	13.4	13.5	17.7	8.6	8.0	24.2	19.5	8.0	18.2	151.0	164.2	12.2	146.4	441.8	86.1	59.7		8.6	163.6	189.5	85.4	299.7	111.3	112.3	43.8	69.2	80.3	42.9	79.8	260.2	3135.2
13	17.5	24.9	15.6	65.9	10.9	8.6	13.8	13.3	24.0	10.0	9.1	26.9	21.5	8.6	22.3	162.4	196.7	15.4	157.9	474.8	92.5	66.6	1.3	11.3	196.9	201.3	94.5	313.0	124.7	123.3	47.9	77.6	83.8	46.7	86.1	279.6	3418.7
14	19.6	27.8	17.0	72.5	12.3	9.6	14.0	13.8	30.1	11.6	10.4	30.4	23.2	9.4	27.1	176.5	211.5	19.3	171.9	506.7	98.9	74.8	2.6	13.3	212.6	214.8	105.0	327.8	140.2	136.5	53.3	85.8	87.7	51.2	92.7	302.3	3725.5
15	20.8	29.8	17.8	56.0	13.4	10.5	14.2	13.8	14.0	9.0	8.6	32.1	24.3	9.8	30.8	186.3	223.0	22.7	182.6	532.2	103.7	80.4	3.5	14.6	218.2	225.1	113.4	339.5	151.7	146.9	58.6	91.1	92.0	55.8	98.5	320.1	3901.9
16	21.1	30.3	17.5	52.3	14.0	11.1	14.1	13.7	10.6	9.0	8.8	33.5	25.1	10.2	33.2	64.2	85.7	23.7	71.0	515.4	107.0	83.1	4.5	15.7	120.0	64.7	117.3	346.2	158.5	151.3	18.2	95.4	94.3	58.4	102.3	327.6	3276.2
17	20.6	30.0	18.4	78.2	14.3	11.2	13.7	13.5	10.0	8.8	8.7	33.5	25.4	10.3	34.9	47.6	64.3	24.2	53.3	527.5	109.1	83.2	5.4	16.4	106.7	55.3	119.3	348.9	162.1	152.2	17.8	97.2	96.1	59.6	104.3	328.9	3257.5
18	20.0	29.9	14.3	82.8	14.2	11.0	16.8	14.9	31.4	11.5	10.6	15.8	25.6	10.3	35.2	38.4	52.2	9.8	43.7	530.3	38.9	84.6	75.1	16.6	92.2	49.2	41.1	354.3	70.2	155.6	16.6	99.3	97.3	61.9	44.5	332.5	2962.3
19	6.9	7.7	6.0	27.1	3.9	3.6	17.6	14.6	34.7	11.0	9.6	12.8	25.8	5.0	33.8	32.2	42.8	7.9	36.0	223.3	32.8	24.8	87.4	9.1	75.4	42.3	32.6	356.4	53.9	53.8	14.9	98.4	97.5	63.0	34.4	119.5	1934.7
20	5.0	5.7	4.4	15.4	3.1	3.0	18.9	15.2	35.4	10.4	8.8	10.7	25.9	3.9	33.5	28.5	36.7	6.9	31.1	177.6	28.4	21.4	97.6	8.1	63.4	36.5	27.0	360.6	45.9	41.7	13.3	98.3	97.8	64.2	28.2	85.8	1755.1
21	4.1	4.6	3.2	11.4	2.6	2.5	17.3	14.3	11.9	5.7	5.2	8.9	26.0	3.2	22.4	25.2	31.3	5.8	26.7	145.2	24.7	17.9	96.1	6.9	52.2	30.7	823.2	359.2	39.7	34.1	11.8	96.0	97.3	63.7	23.5	67.4	2345.3
22	3.3	3.7	2.3	8.8	2.2	2.0	14.9	12.9	6.2	4.2	4.0	7.4	25.7	2.7	18.7	21.9	27.5	5.0	23.8	120.5	21.0	15.0	86.7	6.1	42.9	26.7	20.2	353.1	33.9	29.3	10.1	93.2	94.9	60.9	20.0	55.0	1392.8
23	2.5	2.9	1.4	6.5	1.7	1.7	12.2	10.1	4.5	3.2	3.1	5.7	10.3	2.2	16.3	20.0	23.2	4.3	20.1	100.0	17.6	12.4	77.3	5.1	34.9	22.3	16.9	345.5	28.7	24.4	8.6	88.8	92.4	58.5	16.7	44.5	1223.3
24	1.8	2.1	0.7	4.7	1.4	1.3	9.7	8.2	3.4	2.4	2.3	4.6	7.5	1.8	14.3	16.9	19.9	3.5	17.4	83.2	14.7	10.2	18.5	4.0	28.1	17.8	13.4	337.1	24.3	20.3	7.3	83.9	89.8	55.4	13.6	36.9	1044.2

OCTOBER

DAY HOUR	BUILDING TYPE																																			
	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1							6.5	8.4					3.6		1.9	2.4	1.9			32.1			4.4					59.2				17.4	14.5	11.4	1.9	13.6	186.6
2							6.6	8.6					2.4		4.5					24.7			2.2					44.9				10.7	10.3	7.0		7.6	140.9
3							6.3	9.0					1.4		6.8					18.8					1.9			32.1				4.0	6.2	4.0	0.7	3.1	109.3
4							6.1	8.6					0.5		8.7					13.4					2.7			22.1					3.2	0.8	1.0		85.0
5							5.4	8.4							10.3					9.0					3.4			13.0							1.2		71.3
6							4.9	7.7							11.4					5.3					4.0			5.8							1.4		63.3
7							5.6	8.3							10.9					1.9														6.8			55.3
8							7.4	9.6						1.3	5.7	7.2	10.7			206.6					4.0	18.0							42.9	14.7			340.8
9		3.6					13.9	16.0						4.1	5.8	64.2	91.1		30.2	240.0	40.5	1.8			32.2	113.6		206.7		24.3			53.8	17.0		73.5	1054.2
10	0.7	5.7			0.5		15.9	17.1	1.2					4.7	3.2	84.0	111.4		77.6	263.0	55.3	21.2			71.7	128.2		230.9		50.7	1.2	3.3	58.2	20.2	38.4	156.6	1444.9
11	4.3	12.0			4.9	3.0	18.4	19.5	4.5			11.9	6.8	5.5		97.7	129.0	2.8	91.8	292.3	62.4	30.4			140.5	141.2	33.6	248.8		62.8	21.5	38.0	62.8	23.8	54.9	186.5	1890.3
12	9.2	14.2			6.0	4.7	7.6	8.9	5.4			15.1	17.6	6.2		109.4	143.3	5.1	104.7	375.2	69.3	37.8			155.6	154.0	59.3	264.0	65.6	74.3	26.1	46.8	66.4	27.5	62.8	209.1	2279.6
13	10.3	16.0	8.1	38.2	6.8	5.5	7.2	8.8	9.7	3.6	2.6	18.1	18.4	6.9		119.1	154.6	5.7	115.2	405.1	74.6	44.1			167.7	164.3	64.3	276.0	81.4	83.3	29.7	53.7	69.5	30.7	68.4	228.0	2537.2
14	11.3	17.2	10.5	38.2	7.7	6.1	7.8	8.8	12.6	7.4	6.7	20.5	19.8	7.3	0.4	125.9	162.2	6.2	121.8	428.1	79.6	47.9		4.8	177.4	173.2	71.0	286.3	89.4	91.0	32.5	59.9	71.8	33.3	73.1	238.4	2713.8
15	11.7	17.9	10.4	34.9	8.5	6.7	7.9	9.3	10.8	5.8	5.3	22.3	20.8	7.8	12.0	130.4	167.6	6.6	128.5	448.7	83.2	51.1		7.9	185.2	178.7	76.4	293.0	96.5	96.0	35.6	63.8	74.6	36.2	77.1	245.7	2861.1
16	11.3	17.3	9.6	34.5	8.8	7.2	7.8	9.2	9.0	5.9	5.6	22.6	21.5	8.1	13.0	48.5	66.5	6.7	51.6	427.6	85.7	50.6		8.6	90.3	46.9	76.2	296.2	97.5	96.1	10.7	66.8	76.4	37.4	79.3	245.5	2346.9
17	10.4	16.4	8.1	44.7	8.8	7.2	7.2	8.8	8.0	5.9	5.6	21.8	21.7	8.2	13.3	34.3	49.9	7.8	38.8	431.2	86.3	49.9		9.2	78.1	39.6	75.9	296.9	98.9	95.1	9.7	67.5	77.0	38.3	80.2	243.6	2289.6
18	9.3	15.7	5.8	46.6	8.3	6.8	5.2	6.1	9.4	6.6	6.3	9.9	21.7	8.0	11.6	25.5	36.7	3.7	28.0	428.0	24.1	49.3		9.0	59.4	32.7	25.5	29.8	45.4	96.4	8.0	67.3	77.2	39.9	32.3	244.7	1698.2
19	2.7	3.6	0.4	19.5	1.6	4.2	3.7	4.9	10.5	5.5	5.1	6.8	22.0	3.5	10.8	20.4	29.1	2.7	22.2	179.5	19.2	15.7	13.4	4.5	44.9	26.8	19.8	303.5	34.2	33.2	6.6	67.9	78.0	41.2	24.1	96.2	1273.6
20	1.6	2.3		10.3	0.9	0.6	1.8	3.2	9.4	4.9	4.5	4.9	22.3	2.5	11.5	16.9	23.0	1.6	17.5	136.6	16.1	11.8	24.0	3.5	34.0	20.2	15.2	307.2	26.3	25.0	5.1	67.1	79.0	42.1	18.2	68.3	1105.5
21	0.6	1.2		5.2	0.4	0.3		1.7	7.5	1.8	1.6	3.2	22.0	1.9	7.7	13.6	17.6	0.8	13.1	104.3	10.9	8.4	16.7	2.4	23.4	14.6	10.9	301.8	19.4	18.1	3.4	64.6	77.3	40.9	13.5	51.5	931.6
22		0.3		3.0				0.3	4.1	0.8	0.7	1.4	21.7	1.3	6.0	10.3	13.1	0.4	9.4	80.1	7.3	5.6	9.6	1.4	14.6	9.7	7.2	294.6	13.7	12.5	1.8	61.3	75.1	38.4	9.9	38.7	791.7
23				1.2					2.0				8.0	0.8	3.6	7.5	8.5		5.4	60.0	4.0	3.0	2.6	0.3	5.2	5.3	3.9	290.2	8.5	7.6		58.1	73.5	36.5	6.8	29.2	647.7
24									0.5				5.5	0.4	1.9	5.0	5.2		2.7	43.5	1.2		10.0		1.7	1.5		285.0	3.0	2.6		55.1	71.8	34.3	4.1	20.7	565.4

TABLE 1A

NOVEMBER

DAY HOUR	BUILDING TYPE																																			
	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1							5.7	7.7					3.5		2.2					30.9			3.1					57.1				15.6	13.1	9.6	1.3	12.0	169.7
2							5.5	7.8					2.2		5.8					23.6			1.1		1.3			42.4				8.3	9.0	6.2		5.7	132.9
3							5.1	7.6					1.1		8.6					17.8					2.1			30.5				2.6	5.0	2.7	0.8		102.2
4							4.3	7.5					0.3		11.0					12.7					3.0			20.0					2.1		1.1		84.3
5							4.2	7.2							12.7					8.3					3.7			11.5							1.4		74.4
6							3.5	7.0							13.1					4.6					4.4			3.8									62.5
7							3.2	6.5							9.8																			3.6			42.7
8							4.1	7.3							8.6					204.8					4.4								35.6	11.2			293.2
9							11.5	13.6						3.4	8.6	45.7	62.7			237.5	31.2				20.7	98.4		191.4					49.5	12.9		41.4	849.1
10		3.8					14.1	15.9						4.1	7.4	63.1	93.2		57.9	259.5	50.7				50.5	111.6		217.1		22.1			52.9	15.3	25.0	131.3	1222.0
11	1.2	5.5			1.9		16.6	18.3				2.6	3.0	4.8	4.8	78.7	108.3		70.9	276.2	56.3	20.9			103.5	124.2	8.6	232.0		45.1	3.5	12.4	56.5	18.0	43.6	158.2	1510.6
12	4.1	8.6			4.7	3.7	5.2	7.6	1.2			11.8	17.4	5.4	0.7	88.3	122.6	4.5	84.0	289.9	62.3	27.0			140.1	136.2	44.7	246.1		55.2	18.2	36.9	60.0	21.5	55.4	180.3	1829.2
13	5.5	11.6		21.1	5.5	4.4	5.7	8.0	2.9			14.3	17.1	6.1		99.1	134.3	5.0	94.6	375.4	68.5	33.2			152.6	147.4	52.0	259.0	50.3	66.2	21.9	44.0	63.2	25.0	61.0	199.1	2156.0
14	8.3	13.4	3.8	32.0	6.4	5.1	6.8	8.4	6.6	0.8		16.9	18.6	6.6		107.6	144.5	5.5	103.9	400.5	73.3	38.3			165.5	157.9	56.8	27.9	73.3	74.7	25.5	51.3	66.5	28.0	66.3	213.8	2142.9
15	9.3	15.2	7.7	28.4	7.2	5.7	7.5	9.4	8.1	4.4	3.8	16.8	19.8	7.1		117.5	154.1	5.8	112.9	422.9	78.2	43.3		3.1	175.9	167.6	66.8	281.4	82.5	84.7	28.8	56.7	69.7	31.1	71.3	229.0	2575.5
16	9.6	15.8	7.4	26.1	7.7	6.2	7.9	9.6	7.3	4.8	4.5	20.1	20.6	7.5	6.7	43.2	60.8	6.1	45.8	412.7	81.4	46.7		7.0	83.2	41.2	71.3	289.0	89.5	89.9	7.3	60.8	72.0	34.1	75.2	237.5	2178.2
17	8.9	14.7	6.0	39.6	7.8	6.3	6.7	8.3	6.0	4.3	4.0	20.1	20.9	7.6	9.6	30.0	44.8	6.1	33.7	416.6	82.0	46.1		7.5	69.6	33.9	70.0	289.7	89.9	87.5	6.5	61.5	73.2	35.1	76.4	234.3	2126.2
18	8.0	14.0	4.5	42.2	7.4	5.9	4.3	5.5	7.2	5.3	5.0	8.4	21.0	7.5	8.1	22.2	32.8	2.0	24.1	412.6	21.0	44.7		7.4	52.5	27.0	20.8	290.4	37.8	87.8	4.9	61.2	73.2	35.9	29.2	234.5	1811.2
19	1.9	2.8		17.8	0.9	0.5	2.7	4.2	8.6	4.7	4.3	5.9	21.3	3.0	7.6	17.5	25.9	1.4	18.9	168.4	16.3	13.5	5.1	3.3	39.3	21.6	16.5	294.5	27.7	28.7	3.7	61.9	74.2	37.7	21.6	91.9	1138.7
20	0.9	1.7		9.8	0.4	0.1	1.2	2.8	7.6	4.0	3.6	3.8	21.7	2.1	7.3	14.2	20.2	0.9	14.6	125.6	12.4	9.8	19.3	2.1	27.6	16.4	12.3	297.1	20.5	21.3	2.4	62.2	75.1	38.8	15.9	65.5	992.4
21	0.2	0.7		5.8				1.1	6.0	1.1	0.9	2.2	21.6	1.5	4.2	10.9	14.8	0.6	10.3	97.0	8.3	7.1	13.6	1.3	19.0	11.0	8.2	295.1	15.2	14.7	1.2	60.2	74.5	37.8	11.9	49.4	845.1
22		0.2		3.1					3.1	0.2	0.1	0.8	21.4	1.0	2.8	8.5	10.6		6.8	73.9	4.9	4.4	8.6	0.4	9.2	6.5	4.7	291.0	9.8	9.4		57.7	72.9	36.7	8.3	36.7	722.9
23				1.3					1.2				7.7	0.6	1.2	5.6	6.8		3.7	55.0	1.8	1.5	1.5		2.9	2.5	1.7	286.2	5.1	4.9		54.9	71.2	34.6	5.3	27.5	595.4
24													5.2	0.2		3.1	2.8			39.0			6.9					279.3				51.5	69.3	32.1	3.1	19.0	516.9

DECEMBER

DAY HOUR	BUILDING TYPE																																			
	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1								0.3					2.4		10.0					27.1								47.7				6.4	8.5	4.9		4.5	134.2
2								3.2					1.1		12.4					20.0					2.5			34.0					4.5	1.6	0.7		105.9
3								3.7							13.9					14.2					3.6			22.5					1.1		1.1		87.9
4								3.5							10.6					9.1					4.5			12.0									60.9
5								3.5							9.6					4.9								3.9									41.1
6								3.5							9.0																						30.5
7								3.4							8.0																						27.4
8								3.9							6.2					199.8													19.4				241.7
9							2.4	10.9							6.3	29.7	9.5			235.0					2.9	40.2		168.6					46.6	5.9		2.9	573.5
10		3.0					11.3	13.5						3.0	5.0	58.0	87.0		11.7	256.7	44.8				36.0	106.2		210.6					49.6	11.5	10.6	124.1	1061.6
11		4.7					14.1	16.3						4.4	4.2	68.2	100.6		65.4	273.5	51.2	1.7			55.7	116.9		224.5		1.1			53.2	14.4	39.0	149.1	1280.4
12	3.5	6.2			3.8	0.6	3.1	6.0				6.1	16.3	5.0	3.9	82.9	115.2	0.3	76.5	287.1	57.2	21.7			118.3	129.7	19.3	239.4		50.9	5.3		56.8	17.4	48.0	173.0	1620.1
13	4.3	8.8		13.2	4.6	3.5	3.3	6.2	0.7			11.7	16.2	5.5	1.7	92.5	126.9	4.4	86.7	302.2	63.4	27.5			144.3	140.6	47.9	252.2		58.4	17.2	27.4	59.9	21.2	57.3	191.8	1888.8
14	4.8	11.1		29.7	5.2	4.1	3.9	6.8	3.6			13.8	17.7	6.0		99.0	135.4	4.9	94.4	379.7	68.1	32.6			154.0	149.1	51.8	262.2	60.5	65.4	19.6	44.6	62.4	24.0	61.8	203.5	2176.7
15	5.4	11.6	1.4	23.8	5.7	4.6	4.1	6.4	6.2			15.1	18.6	6.4		103.3	139.6	5.2	97.8	398.1	71.4	34.5			161.3	154.7	55.6	269.0	67.1	69.6	22.6	48.3	64.8	26.7	65.5	211.0	2280.1
16	6.4	11.6	5.0	21.6	6.1	4.9	4.3	6.9	5.7			16.1	19.3	6.8		38.1	53.9	5.3	38.9	385.7	74.6	36.8			68.1	34.4	58.8	274.7	71.3	73.1	3.9	52.0	66.7	28.5	68.3	215.0	1875.2
17	5.6	10.9	3.2	26.3	6.1	4.9	2.9	5.4	4.2	2.1	1.0	15.9	19.6	6.9		24.8	37.8	5.3	26.6	387.2	75.9	36.1		5.2	62.6	27.0	59.2	276.6	72.2	72.9	3.1	52.7	67.9	29.8	69.9	214.9	1820.0
18	4.5	9.7	1.6	26.5	5.7	4.6		1.1	2.2	3.2	3.1	5.2	19.6	6.7		17.1	25.9	1.4	17.1	382.7	15.2	34.5		5.0	35.8	20.0	15.3	276.8	28.2	71.5	1.5	52.1	67.9	30.3	24.9	213.0	1514.3
19	0.4	1.2		13.4					2.5	2.2	2.2	2.7	19.8	2.3		12.2	18.8	0.7	11.8	149.2	10.5	9.0		1.1	23.4	13.8	10.2	276.0	19.3	21.3		50.9	67.6	30.6	17.0	84.4	904.4
20		0.4		6.5					2.5	1.7	1.7	0.6	19.9	1.5	2.7	9.0	13.3	0.3	7.5	107.6	5.8	5.2			11.5	8.4	5.9	274.5	10.8	13.2		49.5	67.0	30.0	11.6	59.1	756.4
21				2.8					2.4				19.0	0.8	2.5	5.9	8.1		3.4	77.4	2.5	2.0			4.5	3.0	1.7	271.9	5.0	6.5		47.3	66.0	28.9	7.2	42.4	636.0
22									0.3				19.6	0.3	5.7	2.5	3.6			57.6					2.0			267.3	3.0			44.7	65.0	27.1	4.1	29.7	563.8
23													6.6		8.3					45.3					1.5			263.0				42.3	63.6	25.5	1.7	20.3	501.1
24													4.1		10.7					35.4					2.4			258.5				39.9	61.7	23.8	0.8	11.9	474.7

TABLE 1A

TONNAGE PROFILE BY MONTH

DAY HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.1	114.9	169.7	321.2	546.8	755.1	682.2	723.3	557.4	186.6	169.7	134.2
2	82.6	93.2	94.9	224.8	433.7	634.5	572.0	602.3	447.5	140.9	132.9	105.9
3	61.0	69.2	102.8	152.0	332.6	528.9	475.1	503.8	349.4	109.3	102.2	87.9
4	42.4	48.8	84.0	104.9	241.8	439.7	394.9	417.3	262.8	85.0	84.3	60.9
5	27.6	32.9	71.7	72.1	170.1	361.2	325.5	343.5	197.0	71.3	74.4	41.1
6	22.8	29.1	55.4	54.9	114.1	294.6	265.7	281.2	137.7	63.3	62.5	30.5
7	18.0	27.6	37.7	84.1	193.9	488.2	470.8	438.8	218.2	55.3	42.7	27.4
8	200.6	223.8	295.7	653.1	1053.8	1594.7	1643.6	1536.2	1129.9	340.8	293.2	241.7
9	420.1	438.0	855.2	1409.3	1841.2	2640.7	2760.4	2582.6	2037.7	1054.2	849.1	573.5
10	796.7	791.9	1204.1	1831.2	2200.2	3074.2	3195.8	2951.5	2465.2	1444.9	1222.0	1061.6
11	1130.7	1067.1	1540.5	2204.4	2523.8	3384.8	3494.4	3242.5	2807.6	1890.3	1510.6	1280.4
12	1330.0	1206.6	1833.4	2464.5	2821.7	3692.5	3853.1	3606.6	3126.6	2279.6	1829.2	1620.1
13	1570.6	1433.7	2146.4	2720.4	3139.7	3945.6	4100.7	3943.5	3407.4	2537.2	2156.0	1888.8
14	1732.9	1631.3	2385.4	2981.6	3455.5	4234.8	4261.6	4165.8	3725.5	2709.0	2142.9	2176.7
15	1955.9	1782.3	2492.8	3147.5	3633.2	4426.3	4345.9	4349.1	3887.3	2853.2	2572.4	2280.1
16	1607.9	1540.9	2094.4	2599.0	3039.6	3627.2	3593.9	3632.4	3260.5	2338.3	2169.2	1875.2
17	1574.4	1528.9	2105.2	2392.5	3043.2	2657.2	3553.3	3552.4	3241.1	2280.4	2118.7	1814.8
18	1306.6	1308.8	1838.7	2316.7	2784.6	3336.6	3227.1	3287.1	2945.7	1689.2	1803.8	1509.3
19	762.7	761.3	1553.2	1536.4	1879.3	2247.1	2151.4	2095.9	1925.6	1269.1	1135.4	903.3
20	624.4	619.4	999.7	1339.1	2537.0	1961.4	1909.2	1895.2	1747.0	1102.0	990.3	756.4
21	550.1	548.6	857.6	117.8	1508.8	1783.9	1690.7	1739.1	2338.4	929.2	843.8	636.0
22	509.4	510.5	735.0	1038.7	1357.9	1638.6	1539.3	1595.0	1386.7	790.3	722.5	563.8
23	417.0	467.8	599.2	880.9	1186.7	1480.5	1359.5	1433.0	1218.2	647.4	595.4	501.1
24	423.5	437.3	519.5	746.7	1018.9	1264.4	1180.1	1229.7	1040.3	565.4	516.9	474.7

Table 2A

BUILDING 25910 PLANT COOLING SUMMARY				
CAPACITY TONS	% PLANT CAPACITY	BIN LIMIT–TONS	HOURS PER BIN	HOURS PER REP DAY
4500	10	450	2216	6.07
	20	900	1605	4.40
	30	1350	853	2.34
	40	1800	1092	2.99
	50	2250	916	2.51
	60	2700	610	1.67
	70	3150	428	1.17
	80	3600	489	1.34
	90	4050	336	0.92
	100	4500	215	0.59

Table 3A

ROWLAND
01!Fort Gordon
P1CARLTON SHUFORD
P2DSN 780-6376
P3ATZH-DIC-E
/RECALL F 000045553 S 03 ECIP PROJECT 1: UPGRADE CHILLER PLANT BUILDING 25910 - FORT GORDON

03A !DESCRIPTION OF PROPOSED CONSTRUCTION

***Upgrade chillers, accessories and the chilled water distribution system at the Central Utility Plant, North side of the Ft. Gordon Installation. Several innovative modifications to the central chilled water system are required to meet current and future cooling requirements for all building on the northern half of the facility. Replacement of obsolete equipment with new high efficiency systems will reduce energy requirements significantly while increasing the net cooling capacity for the barracks, classrooms and administrative buildings.

03B !REMARKS

***This Energy conservation measure to replace the existing chilled water system consists of ten ECO's, which were combined to create one comprehensive ECIP. Each ECO was developed from field studies of the North Side Central Utility Plant. The economics of incorporating all ten ECO's is explained in the economic justification section of this document. The ten ECO's are described below to provide extra insight into the comprehensive approach taken.

ECO NO.	DESCRIPTION
6	Chilled water chemical treatment to prolong chillers life.
23	New variable speed chilled water pumping system.
29	Addition of control to permit chilled water temperature adjustment.
33	Reduce make-up water for the chilled water system.
43	Common manifolding of cooling tower water system.
47	Cooling Tower Water treatment automation/instrumentation.
51	Add free cooling capability to chilled water system.
53	Chilled water storage system
85	Replace five inefficient Chillers with three new units.
86	Install instrumentation for Energy Management System

ECO DATA COMPILATION

ECO NO.	DESCRIPTION	COST (FROM LCC)	SAVINGS 1ST YEAR	TOTAL DISCOUNT SAVINGS
6	Chem Treatment-CHW	15,510	27,500	571,040
23	Variable Speed CHW Pumping	440,096	82,278	1,332,935
29	Temp Reset	31,190	6,881	107,418
33	Reduce Make-Up Water	37,427	7,483	112,453
43	Cooling Tower Manifolding	145,154	6,834	111,515
47	Cooling Tower Water Treatment	1,968	8,522	132,125
51	Free Cooling	100,100	40,461	631,596
53	CHW Storage	660,214	179,970	2,652,763
85	Replace Chillers	1,086,972	122,127	1,904,660
86	EMCS Controls & Instrum.	68,456	16,427	256,423
	Totals	2,587,087	501,483	7,812,928

Simple Payback: $\frac{2,587,087}{501,483} = 5.16$

SIR: $\frac{7,812,928}{2,587,087} = 3.02$

03C !PROJECT DESCRIPTION

***This Energy conservation measure provides the plan to design the required upgrade to the Central Utility Plant, North. Removal and replacement of five inefficient chillers with three new ones properly sized to provide incremental increase in the chilled water capacity as the site load varies. The five old chillers being replaced include 3-700 ton units and 2-750 ton units for a combined capacity of 3,600 tons. The three new chillers have capacity of 1-400 ton chiller and 2-1,250 ton chillers for a combined total of 2,900 tons. The new units are sized to match the load change throughout the day, and have the capacity to replenish the chilled water storage system at night. The chilled water storage system will provide the capacity to make up the difference between the older units 3,600 tons and the capacity of the newer unit of 2,900 tons, or 700 tons. Since the peak demand for chilled water occurs over a short t period of time, the chilled water storage system will provide a capacity to meet a peak demand of 4,400 tons of refrigeration. This exceeds current demand by 800 tons and allows for less chiller capacity to meet current and future needs. Repiping of both the chilled water system and condenser water system will provide flexibility in selecting equipment to run. Current piping makes manual selection of equipment difficult and requires excessive manpower to change over as site loads vary. Consequently, it is easier for chilled water to run through all chillers than to try to control valves and pumps to meet load requirements. In addition to providing a new efficient piping design that is easy to operate, variable speed pumps will be introduced to further allow for energy efficient operation under all load conditions. With the addition of instrumentation and control, all chilled water control functions could be handled from a central location reducing the need for plant operators by fifty percent.

03D !REQUIREMENT (Why is it needed now)

****The chilled water system is not meeting current cooling requirements for the buildings served on the north side of the facility. New construction and renovations will increase the capacity on this system to meet current and future requirements. New CFC regulations for chiller refrigerants will require replacement of older chillers, and require system redesign of chilled water distribution by 1997.

If not implemented now, cooling capacity will not meet current or future needs.

03E !CURRENT SITUATION (How is the need currently being met)

***ECO 6

Existing chemical treatment systems serves the condenser side of the chilled water system and are feeding a C-6220 chemical from Industrial Maintenance Corporation into the condenser water system and also adding an A-102 microbiocide by the bucket as the algae begins to build up in the cooling towers. There is no chemical feed on the chilled water side of the system. There is a large volume of make-up water to the chilled water side, which is taken off the fire hose, and is not treated at this time. There isn't any way to treat the make-up water to the chilled water system with the present equipment.

ECO 23

There are two zones and each zone is served by a set of identical pumps, one backing up the other. Existing pumps all have single speed motors. Buildings on the distribution system, in most cases, have pumps to override the increased pressure drop through the building. 3- way valves are at all of the air handling units and fan coil units in the building.

ECO 29

Although the chillers are set to maintain a constant chilled water supply temperature, some water is bypassed through non-operating chillers and the temperature actually varies. The system is set to operate at a constant supply water temperature of approximately 42°F. Actual supply water temperature was measured at 47°F as a result of return water being bypassed through chillers that are not being operated.

ECO 33

There are water meters on the chilled water Zones 1 and 2 to measure the make-up water. In addition to the metered make-up water, there is a fire hose connected, which is unmetered, that supplies water to the chilled water system to maintain a certain supply pressure through the chillers to the various zones. From tests run shutting off pumps, turning valves, and measuring make-up water flow to Zones 1 and 2 chilled water, the leaks are determined to most likely be in the distribution system. Based on HTW meter readings, the leakage rates vary over the course of the year as leaks are found, repaired and developed again. Accurate determination of the make-up water is not possible because the fire hose is connected into the chilled water system, which is unmetered. During field observations it was noted that 29 gpm was expected with flows separately measured from each zone with zones not cross-connected. When they were cross-connected, the flow averaged 12 gpm. Total loss measured for 24 hour period with a 1-1/4 inch branch closed between the make-up water systems was 16,634 gallons, which was less than what was recorded for previous days on the log with the 1-1/4 inch branch open.

ECO 43

Chillers 1, 2, 3, 4A, and 4B have dedicated cooling towers and although the towers are similarly sized for 700 and 750 ton chillers, there is no means of using an alternate cooling tower with a desired chiller. Chillers 5, 6, and 7 are centrifugal chillers that replaced two absorption chillers. The cooling towers were not replaced so that two cooling towers are cross-connected for use with three centrifugal chillers. It is not possible to maintain a fixed condenser water flow for three chillers with two cooling towers. The fact that the chilled water flow is only constant through all chillers if the same pumps are "On", no chillers are valved "Off", and the pressure drop through the chilled water distribution systems remain constant does not make a fixed condensate water flow any more likely.

ECO 47

There is currently water treatment based on a conductivity meter of the cooling tower water, but biocide is added manually by the scoopful only as needed. There is no water treatment for the chilled water loop and this will cause deterioration of the entire chilled water system.

ECO 51

All of the chillers in Building 25910 are either Carrier or York and are not internally convertible to free cooling unless a heat exchanger is added externally.

ECO 53

As the chilled water system requires chilling, the only way to satisfy this now is for the chillers to operate. A chilled water storage system would enable optimization of chiller operation.

ECO 85

See Figure 1A for the existing chilled water schematic for Building 25910. Chillers 1, 2, and 3 are the oldest; chillers 4A and 4B are next in age and next to lowest in efficiency; chillers 5, 6, and 7 were recently added to the Plant to be replaced in lieu of the absorption chillers which have been removed and are the most efficient. Chillers 1, 2, 3, 5, 6, and 7 are 700 ton capacity; chillers 4A and 4B are both 750 ton capacity.

ECO 86

Existing plant controls that are automatic or manual within the plant are not operable remotely by the EMCS by design. EMCS office which is manned 24 hours a day has very few, if any, instrumentation readouts from the plant, and no controllability of the plant with the EMCS. Because EMCS personnel are aware of what is happening in many buildings, they are also aware of what is happening in the chilled water system pertaining to conditions and demands. Currently, the boiler operators are making boiler pressure changes, HTW changes, bringing on and off chillers, cooling towers, and many manual valving operations. However, they are not performing the functions that an EMCS office can to control energy and to improve the operating efficiency of the plant.

03F !IMPACT IF NOT PROVIDED

***If this project is not accomplished, Fort Gordon will continue to use excessive energy to supply chilled

water to the buildings on the north side of the facility. Because of old inefficient chillers and a distribution system that does not respond to reduced load conditions, all equipment must run all the time to provide adequate cooling. The existing system requires high electrical consumption at all times and high demand for electricity during the entire cooling season.

03G !ADDITIONAL

***New construction and renovation projects on the base will increase demand on the chilled water distribution system to respond to new loading conditions. The old chillers use CFC refrigerant which require changes to the old chillers that are cost prohibitive.

03I !RELATED PROJECTS

***ECIP - 45554 - Chilled Water System to Central Utility Plant - Building 25330 South Side

ECIP - 45555 - High Temperature Water Systems North Plant - Building 25910

ECIP - 45556 - High Temperature Water System South Plant - Building 25330
/*

07A !GENERAL JUSTIFICATION DATA

***This ECIP project is required to support the Army wide effort to reduce energy consumption. The project will provide new chillers and variable speed pumps in addition to renovations to the existing piping layout, which will permit better control of the plant. New instrumentation will allow connection to the existing EMCS system.

The project has been coordinated with the installation physical security plan and no security improvements are required.

The project includes ten ECO's combined to provide a comprehensive upgrade to the facility chilled water system. The following justification overview lists the ECO's along with the economic justification.

PROJECT NO. 1 - CHILLED WATER NORTH

ECO DATA COLLECTION

ECO NO.	DESCRIPTION	CONSTRUCTION COST	ANNUAL RECURRING COST	NON-RECURRING COST (-) SAVINGS (+)	COST (From LCC)	ELECTRICAL SAVINGS MMBTU/YR	DEMAND SAVINGS $	SAVINGS 1st YEAR	TOTAL DISCOUNT SAVINGS
6	Chem Treatment-CHW	13,910.40	-4,000	630,000	15,510	0	0	27,500	571,040
23	Variable Speed CHW Pumping	394,703.82	-2,000	0	440,096	5,728.48	0	85,278	1,332,935
29	Temp Reset	27,972.00	0	0	31,190	451.655	0	6,881	107,418
33	Reduce Make-Up Water	33,566.40	5,015	0	37,427	162.015	0	7,483	112,453
43	Cooling Tower Manifolding	130,183.20	0	22,000	145,154	376.38	0	6,834	111,515
47	Cooling Tower Water Treatment	1,765.26	2,500	5,760	1,968	376.38	0	8,522	132,125
51	Free Cooling	89,775.00	0	0	100,100	2,655.64	0	40,461	631,596
53	CHW Storage	592,118.86	0	0	660,214	0	179,970	179,970	2,652,763
85	Replace Chillers	974,862.00	2,000	0	1,086,972	7,884.48	0	122,127	1,904,660
86	EMCS Controls & Instrumentation	61,394.76	0	0	68,456	1,078.17	0	16,427	256,423
	Totals	2,320,251.70	3,515	657,760	2,587,087	18,713.20	179,970	501,483	7,812,928

Simple Payback: $\frac{2,587,087}{501,483} = 5.16$

SIR: $\frac{7,812,928}{2,587,087} = 3.02$

NOTE: See section 7C for detailed cost breakdown.

07B !TRAFFIC ANALYSIS

*** There will be no changes to pedestrian or vehicular traffic as a result of implementing this ECIP.
/*

08B !PRESENT ACCOMMODATIONS AND DISPOSITION

***The physical plant building 25910 housing the chilled water system is adequate to accomodate the new chillers, once the old chillers are removed. The chilled water storage tank will be located outside in a vacant field adjacent to the cooling towers.
/*

09D !RPMA DISCUSSION

***This ECIP will reduce the amount of Real Property Maintenance Required.
/*

10A !ANALYSIS OF DEFICIENCIES

***1) Treatment of makeup water is not being performed on the CHW system. This will shorten the Life of each chiller as well as the pumping and piping systems by 4 years for a total savings of $630,000.
2) Existing constant speed pumping systems do not meet the needs of dynamic changes to the site A/C loads. The pumps generally are set to run continuosly to be certain that capcity is available when needed. A variable speed pumping system designed to meet the dynamic conditions prevailing at the facility will save $107,418.00 annually.
3) The chilled water system is currently run manually. There is little instrumentation and none of the equipment is connected to the existing on site energy management control system(EMCS). The process of operating the plant is labor intensive and susceptable to inefficient operation. By connedcting the central plant to the EMCS sustem an annual savings of $107,418 will be achieved.
4) Excessive makeup water for the chilled water loop is required because of the existing piping design. Changes to the piping system will reduce the excess, conserve water reduce water treatment requirements and simplify the plant operation. Annual savings of $ 73,921 was calculated
5) The cooling tower condenser water pipe installation dedicates each cooling tower to a specific chiller. By manifolding the condenser water system at the towers, advantage can be taken of selecting the combination of chiller and cooling tower that fits current load conditions will save $ 36,800 annually. This condition will also be advantageous for the free cooling cycle.
7) The chilled water and condenser water systems are not capable of free cooling operation. Changes to the piping system and the addition of an appropriate heat exchanger will make free cooling possible, thus reducing the requirements for running chillers during off peak season conditions(fall, winter, spring). An annual savings of $40,461 will be realized.
8) The existing chilled water system meets peak demand conditions with all chillers running near their maximum capacity. This produces peak electrical demand conditions.To reduce the demand conditions, a chilled water storage system will be installed to retain chilled water to be used instead of a chiller during peak demand conditions. An annual savings of $179,970 due to reduce demand charges will be achieved.
9) Four of the eight chillers are at the end of their usefull life. Due to the increasing requirementss for chilled water at facility, the four older chillers will be replace with three new hi efficiency chillers. This will result in an annual savings of $ 122,127.00.

10) The central plant currently is not equipped with sensors or controls to allow interfacing to the existing Energy management and control system. Connection to the EMCS is required because there is a need to coordinate the operation of the chilled water system with the requirements being monitored by the EMCS. Reducing equipment run time and setpoint control will save $ 16427.00 annually.
/*

11D !DECISION ANALYSIS

***The decision analysis was based on grouping the following ECO's together because of their interrelationships to each other. The benefit of each of the ECO's however was determined separately and no attempt was made to determine any additional benefit when all were combined as a whole. The savings and ROI therefore are conservative figures and additional savings can be anticipated by the cummulative affect.

ECO #	Descrition	Cost	1st Yr Savings	Payback Years	SIR	AIRR
6	CHW Chem Trt.	15,410	27,500	.56	36.82	
23	VAR Sp Pmps	440,096	85,278	5.16	3.03	8.97
29	Temp Reset	31,190	6,881	4.53	3.44	9.68
33	Make-up H2O	37427	7,483	5.00	3.00	8.93
43	Tower repipe	145,154	6,834	21.24	.77	1.75
47	CW chem trt	1,968	2,788	.71	21.65	
51	Free Cooling	100,100	40,461	2.47	6.31	13.05
53	CHW Storage	660,214	179,970	3.67	4.02	10.52
85	New Chillers	1,086,972	122,127	8.9	1.75	6.03
86	EMCS control	68,456	16,427	4.17	3.75	10.14
	TOTAL	2,587,087	495,749	5.22	2.98	

***The following is a detailed cost breakdown of each of the ECO's. Refer to the table in 7A General Justification Data which summarizes these costs.

ECO 6 - LCCA

1.	Investment		
	A. Construction Cost	$	13,910.00
	B. SIOH	$	765.00
	C. Design Cost	$	835.00
	D. Total Cost (1A + 1B + 1C)	$	15,510.00
2.	Energy Savings	$	-5,994.00
3.	Non Energy Savings	$	571,040.00
4.	First Year Dollar Savings	$	27,500.00
5.	Simple Payback Period	$	.56 Years
6.	Total Net Discounted Savings	$	571,040.00
7.	Savings to Investment Ratio	$	36.82

ECO 23 - LCCA

1.	Investment		
	A. Construction Cost	$	394,704.00
	B. SIOH	$	21,709.00
	C. Design Cost	$	23,683.00
	D. Total Cost (1A + 1B + 1C)	$	440,096.00
2.	Energy Savings	$	-266.00
3.	Non Energy Savings	$	-29,480.00
4.	First Year Dollar Savings	$	85,278.00
5.	Simple Payback Period	$	5.16 Years
6.	Total Net Discounted Savings	$	1,332,935.00
7.	Savings to Investment Ratio	$	3.03

ECO 29 - LCCA

1.	Investment		
	A. Construction Cost	$	27,972.00
	B. SIOH	$	1,539.00
	C. Design Cost	$	1,679.00
	D. Total Cost (1A + 1B + 1C)	$	31,190.00
2.	Energy Savings	$	-5,542.00
3.	Non Energy Savings	$	0.00
4.	First Year Dollar Savings	$	6,881.00
5.	Simple Payback Period	$	4.53 Years
6.	Total Net Discounted Savings	$	107,418.00
7.	Savings to Investment Ratio	$	3.44

ECO 33 - LCCA

1.	Investment		
	A. Construction Cost	$	33,566.00
	B. SIOH	$	1,847.00
	C. Design Cost	$	2,014.00
	D. Total Cost (1A + 1B + 1C)	$	37,427.00
2.	Energy Savings	$	-4,833.00
3.	Non Energy Savings	$	73,921.00
4.	First Year Dollar Savings	$	7,483.00
5.	Simple Payback Period	$	5.00 Years
6.	Total Net Discounted Savings	$	112,453.00
7.	Savings to Investment Ratio	$	3.00

ECO 43 - LCCA

1.	Investment		
	A. Construction Cost	$	130,183.00
	B. SIOH	$	7,160.00
	C. Design Cost	$	7,811.00
	D. Total Cost (1A + 1B + 1C)	$	145,145.00
2.	Energy Savings	$	-5,618.00
3.	Non Energy Savings	$	22,000.00
4.	First Year Dollar Savings	$	6,834.00
5.	Simple Payback Period	$	21.24 Years
6.	Total Net Discounted Savings	$	111,515.00
7.	Savings to Investment Ratio	$	.77

ECO 47 - LCCA

1.	Investment		
	A. Construction Cost	$	1,765.00
	B. SIOH	$	97.00
	C. Design Cost	$	106.00
	D. Total Cost (1A + 1B + 1C)	$	1,968.00
2.	Energy Savings	$	-5,994.00
3.	Non Energy Savings	$	42,610.00
4.	First Year Dollar Savings	$	2,788.00
5.	Simple Payback Period	$	.71 Years
6.	Total Net Discounted Savings	$	42,610.00
7.	Savings to Investment Ratio	$	21.65

ECO 51 - LCCA

1.	Investment		
	A. Construction Cost	$	89,775.00
	B. SIOH	$	4,938.00
	C. Design Cost	$	5,387.00
	D. Total Cost (1A + 1B + 1C)	$	100,100.00
2.	Energy Savings	$	-3,338.00
3.	Non Energy Savings	$	0.00
4.	First Year Dollar Savings	$	40,461.00
5.	Simple Payback Period	$	2.47 Years
6.	Total Net Discounted Savings	$	631,596.00
7.	Savings to Investment Ratio	$	6.31

ECO 53 - LCCA

1.	Investment		
	A. Construction Cost	$	592,119.00
	B. SIOH	$	32,567.00
	C. Design Cost	$	35,528.00
	D. Total Cost (1A + 1B + 1C)	$	660,214.00
2.	Energy Savings	$	-5,994.00
3.	Non Energy Savings	$	0.00
4.	First Year Dollar Savings	$	179,970.00
5.	Simple Payback Period	$	3.67 Years
6.	Total Net Discounted Savings	$	2,652,763.00
7.	Savings to Investment Ratio	$	4.02

ECO 85 - LCCA

1.	Investment		
	A. Construction Cost	$	974,862.00
	B. SIOH	$	53,618.00
	C. Design Cost	$	58,492.00
	D. Total Cost (1A + 1B + 1C)	$	1,086,972.00
2.	Energy Savings	$	1,890.00
3.	Non Energy Savings	$	29,480.00
4.	First Year Dollar Savings	$	122,127.00
5.	Simple Payback Period	$	8.90 Years
6.	Total Net Discounted Savings	$	1,904,660.00
7.	Savings to Investment Ratio	$	1.75

ECO 86 - LCCA

1.	Investment		
	A. Construction Cost	$	61,395.00
	B. SIOH	$	3,377.00
	C. Design Cost	$	3,684.00
	D. Total Cost (1A + 1B + 1C)	$	68,456.00
2.	Energy Savings	$	-3,917.00
3.	Non Energy Savings	$	0.00
4.	First Year Dollar Savings	$	16,427.00
5.	Simple Payback Period	$	4.17 Years
6.	Total Net Discounted Savings	$	256,423.00
7.	Savings to Investment Ratio	$	3.75

11E !ECONOMIC ANALYSIS

***ECO 6

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Chemical Feed System	1	LS	3,500	3,500	2,500	2,500	$6,000.00
Test Coupon	1	LS	2,000	2,000	2,000	2,000	$4,000.00
					SUBTOTAL		$11,040.00
					20% OH (GC ONLY)		$2,208.00
					SUBTOTAL GC'S WORK		$13,248.00
					SUBTOTAL (GC & SUBS)		$13,248.00
					5% CONTINGENCY		$662.40
					TOTAL		$13910.40

ECO 23

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Secondary Pumps	6	EA	8,000	48,000	1,000	6,000	$54,000.00
Piping	1	LS	10,000	10,000	20,000	20,000	$30,000.00
Controls & Instrumentation	1	LS	36,000	36,000	30,000	30,000	$66,000.00
Variable Speed Drive (200HP)	1	LS	17,500	17,500	1,000	1,000	$18,500.00
Switches for 200HP Drive	2	EA	4,340	8,680	1,500	3,000	$11,680.00
Piping Changes in Bldgs (96)	1	LS	28,000	28,000	19,200	19,200	$47,200.00
Controls & Instr. in Plant	1	LS	5,000	5,000	2,000	2,000	$7,000.00
Electrical Work	1	LS	2,000	2,000	10,000	10,000	$12,000.00
Variable Speed Drive (300HP)	1	LS	28,400	28,400	1,000	1,000	$29,400.00
Switches for 300HP Drive	2	EA	4,340	8,680	1,500	3,000	$11,680.00
					SUBTOTAL		$313,257.00
					20% OH (GC ONLY)		$62,651.40
					SUBTOTAL GC'S WORK		$375,908.40
					SUBTOTAL (GC & SUBS)		$375,908.40
					5% CONTINGENCY		$18,795.42
					TOTAL		$394,703.82

ECO 29

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Controls	1	LS	10,000	10,000	10,000	10,000	$20,000.00
					SUBTOTAL		$22,200.00
					20% OH (GC ONLY)		$4,440.00
					SUBTOTAL GC'S WORK		$26,640.00
					SUBTOTAL (GC & SUBS)		$26,640.00
					5% CONTINGENCY		$1,332.00
					TOTAL		$27,972.00

ECO 33

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Flow Meters	9	LS	1,500	9,000	1,000	6,000	$15,000.00
Temp RTD in Distribution Pipe	6	EA	500	3,000	1,000	6,000	$9,000.00
					SUBTOTAL		$26,640.00
					20% OH (GC ONLY)		$5,328.00
					SUBTOTAL GC'S WORK		$31,968.00
					SUBTOTAL (GC & SUBS)		$31,968.00
					5% CONTINGENCY		$1,598.40
					TOTAL		$33,566.40

ECO 43

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Piping Materials	1	LS	30,000	30,000	30,000	30,000	$60,000.00
Condenser Water Pumps	6	EA	4,000	24,000	1,000	6,000	$30,000.00
Electrical	1	LS	1,500	1,500	2,500	2,500	$4,000.00
					SUBTOTAL		$103,320.00
					20% OH (GC ONLY)		$20,664.00
					SUBTOTAL GC'S WORK		$123,984.00
					SUBTOTAL (GC & SUBS)		$123,984.00
					5% CONTINGENCY		$6,199.20
					TOTAL		$130,183.20

ECO 47

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Chemical Feed	1	LS	1,000	1,000	300	300	$1,300.00
					SUBTOTAL		$1,401.00
					20% OH (GC ONLY)		$280.20
					SUBTOTAL GC'S WORK		$1,681.20
					SUBTOTAL (GC & SUBS)		$1,681.20
					5% CONTINGENCY		$84.06
					TOTAL		$1,765.26

ECO 51

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Modify Cooling Tower w/ Heat Exchange	1	LS	40,000	40,000	25,000	25,000	$65,000.00

SUBTOTAL 1	$65,000.00
5% SALES TAX	$2,000.00
17% LABOR TAX	$4,250.00
SUBTOTAL 2	$71,250.00
20% GC OH & PROFIT	$14,250.00
SUBTOTAL GC WORK	$85,500.00
5% CONTINGENCY	$4,275.00
TOTAL	$89,775.00

ECO 53

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Install Underground Chilled Water Tank	1	LS	400,000	400,000	42,650	42,650	$442,650.00

SUBTOTAL 1	$442,650.00
5% SALES TAX	$20,000.00
17% LABOR TAX	$7,250.50
SUBTOTAL 2	$469,950.50
20% GC OH & PROFIT	$93,980.10
SUBTOTAL GC WORK	$563,880.60
5% CONTINGENCY	$28,194.03
TOTAL	$592,074.63

ECO 85

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
New 400 Ton Chiller Installation	1	LS	110,000	110,000	20,000	20,000	$130,000.00
New 1250 Ton Chiller	2		280,000	560,000	20,000	40,000	$600,000.00

SUBTOTAL 1	$730,000.00
5% SALES TAX	$33,500.00
17% LABOR TAX	$10,200.00
SUBTOTAL 2	$773,700.00
20% GC OH & PROFIT	$154,740.00
SUBTOTAL GC WORK	$928,440.00
5% CONTINGENCY	$46,422.00
TOTAL	$974,862.00

ECO 86

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Chiller Efficiency Software	1	LS			10,000	10,000	$10,000.00
Distribution System Flow Meters	1	LS	3,000	3,000	2,000	2,000	$5,000.00
Distribution System Flow Meters	1	LS	3,000	3,000	2,000	2,000	$5,000.00
Operate. Controls-Chillers, Valves	1	LS	3,500	3,500	700	700	$4,200.00
Temps-CHW, Cond Water	1	LS	200	200	1,000	1,000	$1,200.00
Free Cooling Valve Indicators	1	LS	400	400	400	400	$800.00
Flow Switches-CHW Storage	1	LS	5,200	5,200	800	800	$6,000.00
Chillers Amps	1	LS	2,000	2,000	800	800	$2,800.00
Pressures-CHW, RET, Supply and Storage	1	LS	900	900	900	900	$1,800.00
Variable Speed & Switch Control	1	LS	1,000	1,000	1,500	1,500	$2,500.00
Chiller Pump Controls	1	LS	1,000	1,000	1,500	1,500	$2,500.00
Condenser Pump Controls	1	LS	800	800	1,200	1,200	$2,000.00
					SUBTOTAL 1		$43,800.00
					5% SALES TAX		$1,050.00
					17% LABOR TAX		$3,876.00
					SUBTOTAL 2		$48,726.00
					20% GC OH & PROFIT		$9,745.20
					SUBTOTAL GC WORK		$58,471.20
					5% CONTINGENCY		$2,923.56
					TOTAL		$61,394.76

/*

12A !CRITERIA FOR PROPOSED CONSTRUCTION

***Construction will conform to existing guidelines of architectural design and building construction, specifically the AEI Design Guide (March 1987), the Corps of Engineers Guide Specifications CEGS 13947 thru 13949 for EMCS, and TM 5-812-2.

13B !FURNISHINGS AND EQUIPMENT DISCUSSION

***1) Four chillers will be replaced with three new chillers.
2) Two variable speed pumps will be added to serve the primary chilled water loop.
3) Rerouting of existing pipes will permit more efficient operation and utilization of new and existing equipment.
4) New sensors and controls will be installed to automate the chilled water system functions.
/*

14B !SURVIVAL MEASURES

This project will upgrade the existing chilled water system and is not suitable for inclusion as a protective shelter.

15A !ENVIRONMENTAL DOCUMENTATION

***The refrigerant in four old chillers will need to be reclaimed. Permits will be required. The refrigerants have market value and can be disposed of by selling at current market value. There are no other environmental issues.

15B1 !SUMMARY OF ENVIRONMENTAL CONSEQUENCES

***We have reviewed this project and determined that an environemtnal impact staement, pursuant to PL 91-190, is not required. We have assessed this project and determined that it will not contribute significantly to air and/or water pollution.
/*

16A1 !EVALUATION OF FLOOD HAZARDS

***The renovation is to an existing plant. No history of flooding has been recorded.
/*

19A !SUMMARY OF ENERGY REQUIREMENTS

***The existing electric utility system in adequate to support the modifications, upgrades and new equipment recommendations. No changes will be required to meet the requirements and modifications. Peak load requirements will actually be reduced. Equipment operation will reflect the changing load requirements throughout the day allowing chillers and pumps to be scheduled more efficiently, thus reducing electric consumption and demand.

The engineering study reports electric consumption reduction to be 15,586,741 KWH and a demand reduction of 2,981.78 from first order effects to reducing equipment use, and chilled water storage. A total discounted savings of $7,723,413 will be realized.

19B !SUMMARY OF UTILITY SUPPORT

***The central utility plant connected load will be reduced by 15%. The existing electric utilities supplied to the central plant is adequate and will not require additional capacity to be added.

20B !HAZARDS TO HANDICAPPED PERSONS

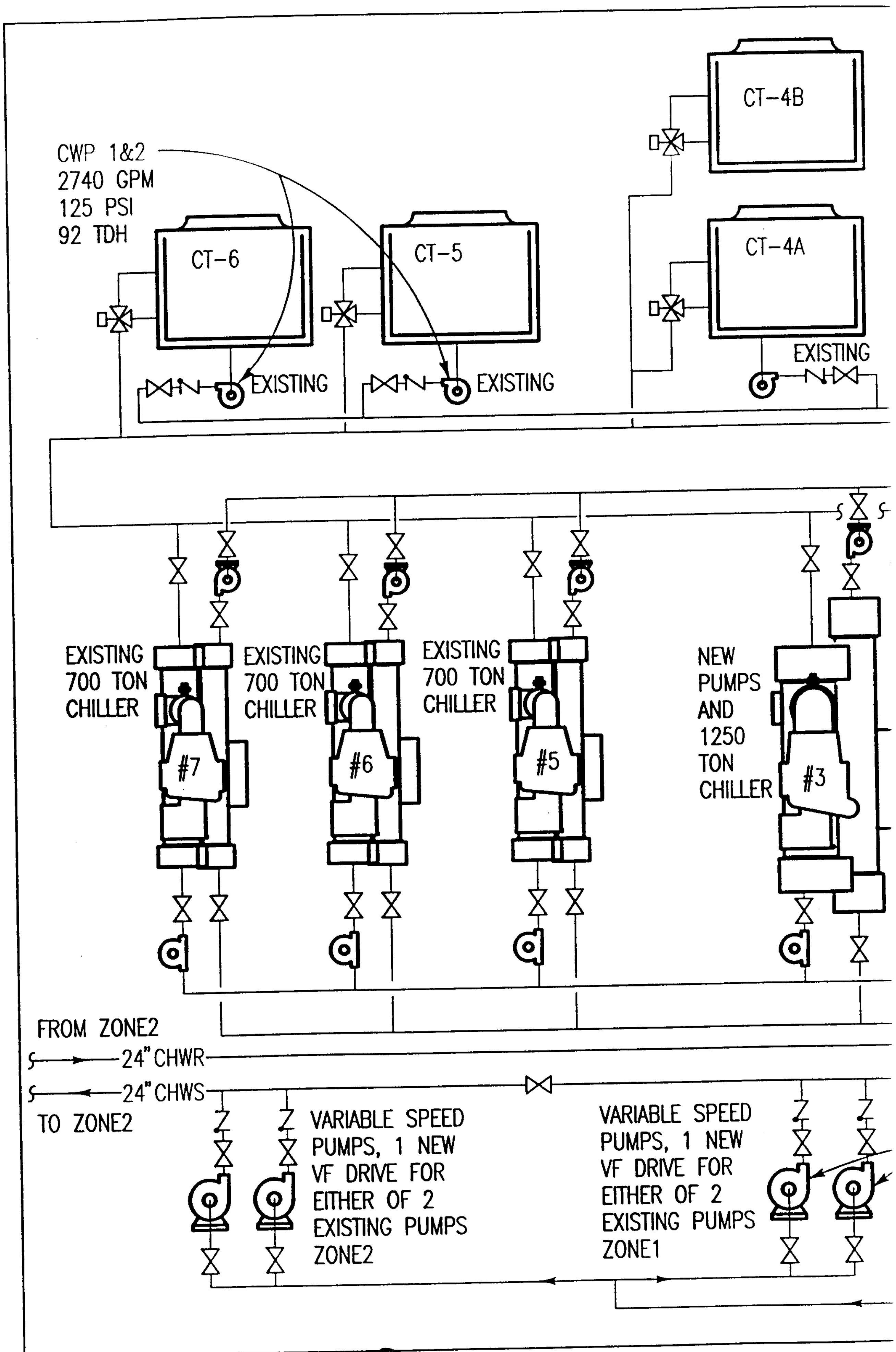
***Existing conditions within the physical plant is considered hazardous to unauthorized personnel. Signs and warnings are posted to alert unauthorized personnel access is restricted to authorized personnel and visitors with prior approval.

20C !HANDICAP PROVISIONS

***In accordance with Public Law 90-480, no provisions for the handicapped will be made in the project since the facility is used and operated solely by able bodied personnel. However, the main floor of the facility is at ground level and is handicap accessible.
/*

22B !PHYSICAL SECURITY

***Project is not considered for commercial activity. The physical plant upgrade to the existing Central Utility Plant will serve the north side of Ft. Gordon. Provisions of DA circular 235-1 are not applicable to this project.
/*



CT-4B
CWP 1&2
2740 GPM
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CT-6
CT-5
CT-4A
EXISTING
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700 TON
CHILLER
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FROM ZONE2
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VF DRIVE FOR
EITHER OF 2
EXISTING PUMPS
ZONE2
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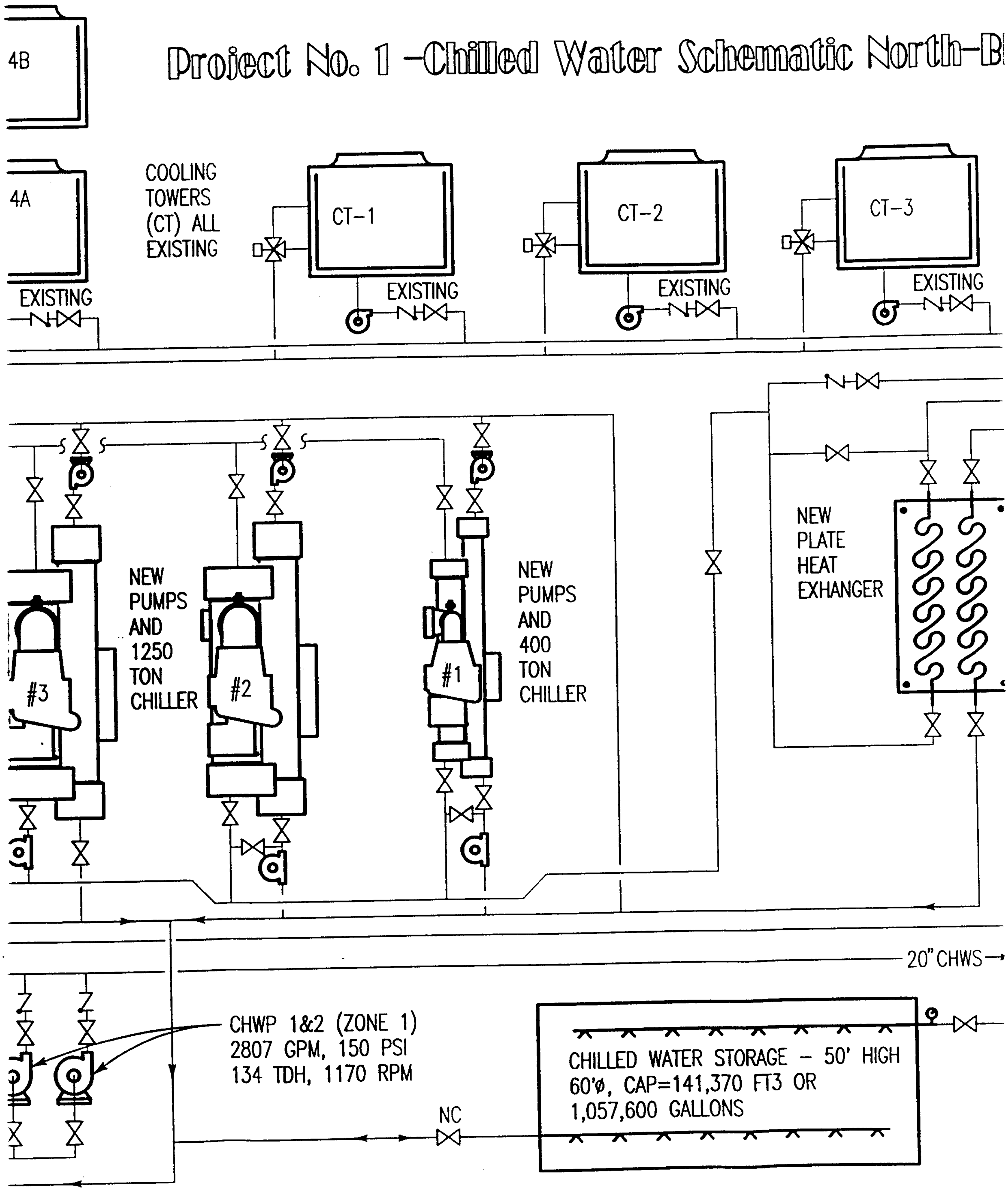
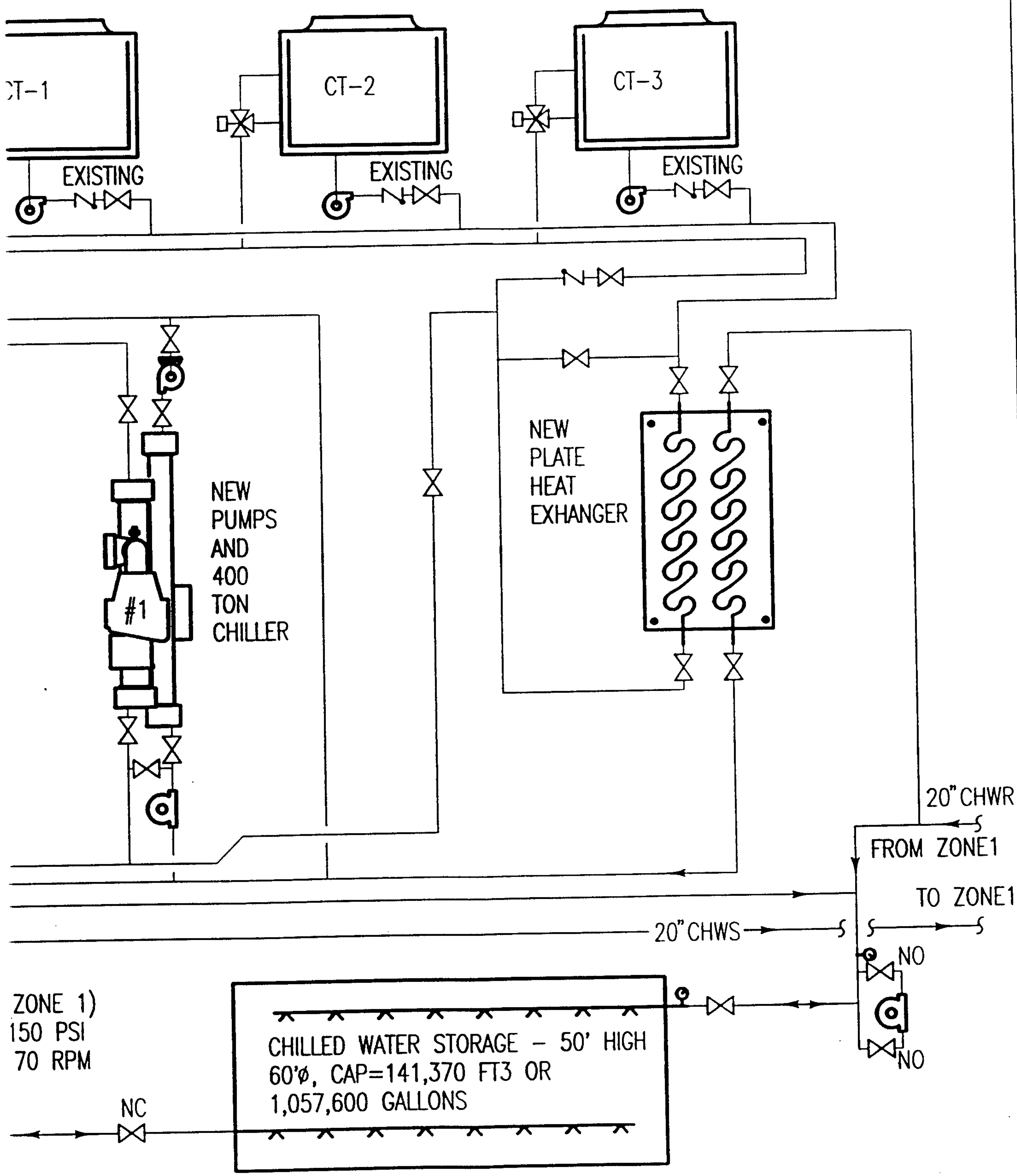
VF DRIVE FOR
EITHER OF 2
EXISTING PUMPS
ZONE1

Project No. 1 -Chilled Water Schematic North-B



). 1 – Chilled Water Schematic North-Bldg. 25910



3

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO006
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON, AUREGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: ECO006 BOILER/CHILLER ENERGY STUDY
FISCAL YEAR 1994 DISCRETE PORTION NAME: CHW CHEMICAL TREATMENT
ANALYSIS DATE: 09-08-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$	13910.
B. SIOH	$	765.
C. DESIGN COST	$	835.
D. TOTAL COST (1A+1B+1C)	$	15510.
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$	0.
F. PUBLIC UTILITY COMPANY REBATE	$	0.
G. TOTAL INVESTMENT (1D - 1E - 1F)	$	15510.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5994.	$ 0.		$ 0.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ -4000.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ -58960.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. CHW PIPING 16 YRS	$9,000,000.	16	.61	5490000.
2. CHW PIPING 20 YRS	$ -9,000,000.	20	.54	-4860000.
d. TOTAL	$ 0.			630000.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) $ 571,040.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd /(YRS ECONOMIC LIFE)) $

5. SIMPLE PAYBACK PERIOD (1G/4) YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 571040.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 36.82
(IF < 1 PROJECT DOES NOT QUALIFY)
*** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: EC0023
LCCID 1.080

INSTALLATION & LOCATION: FT.GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 1 CHILLED WATER NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: VARIABLE SPEED PUMPING
ANALYSIS DATE: 09-17-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 394704.		
B. SIOH	$ 21709.		
C. DESIGN COST	$ 23683.		
D. TOTAL COST (1A+1B+1C)	$ 440096.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 440096.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	5728.	$ 87278.	15.61	$ 1362415.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-266.	$ 87278.		$ 1362415.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ -2000.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ -29480.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ -29480.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 85278.

5. SIMPLE PAYBACK PERIOD (1G/4) 5.16 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 1332935.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 3.03
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 8.97 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO029
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FORT GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: BOILER/CHILLER ENERGY STUDY
FISCAL YEAR 1994 DISCRETE PORTION NAME: CONTROLS
ANALYSIS DATE: 06-15-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 27972.		
B. SIOH	$ 1539.		
C. DESIGN COST	$ 1679.		
D. TOTAL COST (1A+1B+1C)	$ 31190.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 31190.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	452.	$ 6881.	15.61	$ 107418.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5542.	$ 6881.		$ 107418.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 6881.

5. SIMPLE PAYBACK PERIOD (1G/4) 4.53 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 107418.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 3.44
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 9.68 %

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: ECO033
LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 1 CHILLED WATER NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: MAINTENANCE
ANALYSIS DATE: 09-17-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 33566.		
B. SIOH	$ 1847.		
C. DESIGN COST	$ 2014.		
D. TOTAL COST (1A+1B+1C)	$ 37427.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 37427.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	162.	$ 2468.	15.61	$ 38532.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-4833.	$ 2468.		$ 38532.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 5015.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 73921.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 73921.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 7483.

5. SIMPLE PAYBACK PERIOD (1G/4) 5.00 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 112453.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 3.00
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 8.93 %

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
STUDY: ECO043
LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 1 CHILLED WATER NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: CONDENSER PIPING
ANALYSIS DATE: 09-17-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 130183.		
B. SIOH	$ 7160.		
C. DESIGN COST	$ 7811.		
D. TOTAL COST (1A+1B+1C)	$ 145154.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 145154.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	376.	$ 5734.	15.61	$ 89515.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5618.	$ 5734.		$ 89515.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 0.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. CHILLERS 19 YRS	$1100000.	19	.56	616000.
2. CHILLERS 20 YRS	$ -1,100,000	20	.54	-594000.
d. TOTAL	$ 0.			22000.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 22000.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd /(YRS ECONOMIC LIFE))$

5. SIMPLE PAYBACK PERIOD (1G/4) YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 111515.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .77
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 1.75 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: EC0047
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 1 CHILLED WATER NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: WATER TREATMENT
ANALYSIS DATE: 01-13-95 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 1765.	
B. SIOH	$ 97.	
C. DESIGN COST	$ 106.	
D. TOTAL COST (1A+1B+1C)	$ 1968.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 1968.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	376.	$ 5734.	15.61	$ 89515.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5618.	$ 5734.		$ 89515.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 2500.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 36850.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. COOLING TOWER 20 YRS	$-144000.	20	.54	-77760.
2. COOLING TOWER 18 YRS	$ 144000.	18	.58	83520.
d. TOTAL	$ 0.			5760.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 42610.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd4/(YRS ECONOMIC LIFE)) $ 8522.

5. SIMPLE PAYBACK PERIOD (1G/4) .23 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 132125.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 67.13
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 27.23 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: EC0051
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 1 CHILLED WATER NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: FREE COOLING
ANALYSIS DATE: 09-17-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 89775.		
B. SIOH	$ 4938.		
C. DESIGN COST	$ 5387.		
D. TOTAL COST (1A+1B+1C)	$ 100100.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 100100.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	2656.	$ 40461.	15.61	$ 631596.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-3338.	$ 40461.		$ 631596.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL-RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 40461.

5. SIMPLE PAYBACK PERIOD (1G/4) 2.47 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 631596.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 6.31
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 13.05 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO053
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT.GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 1 CHILLED WATER NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: CHW STORAGE
ANALYSIS DATE: 09-18-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 592119.		
B. SIOH	$ 32567.		
C. DESIGN COST	$ 35528.		
D. TOTAL COST (1A+1B+1C)	$ 660214.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 660214.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 179970.	14.74	$ 2652763.
N. TOTAL		-5994.	$ 179970.		$ 2652763.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 179970.

5. SIMPLE PAYBACK PERIOD (1G/4) 3.67 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 2652763.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 4.02
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 10.52 %

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: ECO085
LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 1 CHILLED WATER NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: REPLACE CHILLERS
ANALYSIS DATE: 09-17-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 974862.		
B. SIOH	$ 53618.		
C. DESIGN COST	$ 58492.		
D. TOTAL COST (1A+1B+1C)	$ 1086972.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 1086972.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	7884.	$ 120127.	15.61	$ 1875180.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		1890.	$ 120127.		$ 1875180.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 2000.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 29480.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 29480.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 122127.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.90 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 1904660.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.75
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 6.03 %

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: ECO086
LCCID 1.080

INSTALLATION & LOCATION: FT.GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 1 CHILLED WATER NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: EMCS CONTROLS
ANALYSIS DATE: 09-18-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 61395.		
B. SIOH	$ 3377.		
C. DESIGN COST	$ 3684.		
D. TOTAL COST (1A+1B+1C)	$ 68456.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 68456.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	1078.	$ 16427.	15.61	$ 256423.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-3917.	$ 16427.		$ 256423.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 0.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 16427.

5. SIMPLE PAYBACK PERIOD (1G/4) 4.17 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 256423.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 3.75
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 10.14 %

PROJECT NO. 2

CHILLED WATER SOUTH

BUILDING 25330

GENERAL PROJECT NO. 2

GENERAL DESCRIPTION:

See the drawing of Project No. 2 - Chilled Water Schematic South - Building 25330 for new and existing equipment and piping to make this project work. Each ECO defines the necessary equipment modification with a savings justification for its implementation. Existing chillers are low efficiency. Two of the existing chillers will be replaced with new high efficiency chillers, and the newest two chillers that are existing will remain for backup. With the new chilled water storage system, no more than 900 tons will be required at any time from the chillers, which will set a new lower load demand for the plant. This project is similar to Project No. 1 for the larger Building 25910 with the following exceptions:

1. The chillers are smaller.
2. There is one cooling tower per chiller, so the piping is a lot less.
3. The chilled water storage system is less.
4. Because the cooling equipment is shut down in the winter time, there is no need for the free cooling heat exchanger that is used as an energy saver in Project No. 1.
5. Because there is not much make-up water loss, the ECO to reduce make-up water is in Project No. 1, but not Project No. 2.

SUMMARY:

The composite of all of these ECO's for Project No. 2 are totaled up on the following page. We have computed the cost of the first year savings and the total discounted savings which allows us to compute the SIR of 4.37 in a simple payback of 3.60 years.

LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: PROJ002

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: 2 CHILLED WATER SOUTH

FISCAL YEAR 1994 DISCRETE PORTION NAME: COMPOSITE

ANALYSIS DATE: 02-19-95 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 1011653.		
B. SIOH	$ 55641.		
C. DESIGN COST	$ 60700.		
D. TOTAL COST (1A+1B+1C)	$ 1127994.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 1127994.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	14053.	$ 214114.	15.61	$ 3342326.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 75868.	14.74	$ 1118294.
N. TOTAL		8059.	$ 289982.		$ 4460621.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 2000.
 (1) DISCOUNT FACTOR (TABLE A) 14.74
 (2) DISCOUNTED SAVING/COST (3A X 3A1) $ 29480.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. TOTAL	$ 434184.	0	1.00	434184.
d. TOTAL	$ 434184.			434184.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 463664.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 313692.

5. SIMPLE PAYBACK PERIOD (1G/4) 3.60 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 4924285.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 4.37
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 10.98 %

PROJECT NO. 2 - CHILLED WATER SOUTH

ECO DATA COMPILATION

ECO NO.	DESCRIPTION	CONSTRUCTION COST	ANNUAL RECURRING COST	NON-RECURRING DISCOUNTED COST (-) SAVINGS (+)	COST (From LCC)	ELECTRICAL SAVINGS MMBTU/YR	NAT GAS SAVINGS MMBTU/YR	DEMAND SAVINGS $	SAVINGS 1st YEAR	TOTAL DISCOUNT SAVINGS
7	Chem Treatment-CHW	13,910.40	-4,000	420,000	15,510	0	0	0	17,000	361,040
20	Chiller Replacement	370,062.00	2,000	0	412,620	1,008.60	0	0	155,632	2,427,680
24	Variable Speed Pumping	285,314.40	0	0	318,126	3,310.36	0	0	50,436	787,309
30	CHW Temperature Riser	13,986.00	0	0	15,596	157.05	0	0	2,393	37,351
44	Cooling Tower Manifolding	30,618.00	2,000	10,728	34,139	32.9	0	0	3,037	48,033
48	Condenser Water Chemical Treatment	1,765.26	2,000	3,456	1,968	130.87	0	0	4,167	64,061
54	Chilled Water Storage	252,126.00	0	0	281,121	0	0	75,868	75,868	1,118,298
87	EMCS Controls and Instrumentation	43,870.68	0	0	48,917	338.54	0	0	5,158	80,516
	Totals	1,011,652.70	2,000	434,184	1,127,997	14,053.32	0	75,868	313,691	4,924,288

Simpler Payback: $\frac{1,127,997}{313,691}$ = 3.60 years

SIR: $\frac{4,924,288}{1,127,997}$ = 4.37

ECO METHODOLOGY FORM

ECO NAME:	Treatment of Make-up Water to Chilled Water System
ECO NUMBER:	7
TYPE: BLDG SYSTEM:	Bldg. 25330 Cooling
EXISTING CONDITIONS:	The existing chemical treatment system serves the condenser side of the chilled water system and is feeding a C-6220 chemical from Industrial Maintenance Corporation into the condenser water system. Additionally an A-102 microbicide is added to each cooling tower by the bucket as the algae begins to build up in the cooling towers. There is no chemical feed on the chilled water side of the system. Since there is a fairly large volume of make-up water to the chilled water side, water that is fed into the system is not treated water at this time, nor is there any way to treat the water with the present equipment.
PROPOSED CHANGE:	The proposed change is a coupon system where various materials are located in contact with the chilled water and to determine what chemicals need to be added to the chilled water system to keep the various coupon materials that may come into contact with the chilled water in the distribution piping from corroding. The coupon system is not necessary on the condenser water side because there is actually conductivity meters that are measuring the water quality on that side, and there is a relatively small amount of piping from the cooling towers to the chillers.
CALCULATION & COST METHODOLOGY:	The savings would be the increased life of the chilled water piping system and would be offset by the increased cost in chemicals and installation of the coupons.

Costs:

Installation of Coupon

Materials	$2,000	Labor	$2,000

Chemical Feed System

Materials	$3,500	Labor	$2,500 chilled water side only.

Because chemicals are not being added, the increased cost of chemicals will be $4,000 per year. All of these costs will be offset by the savings of the life of the chilled water system. Replacement cost is $6 million. Life of piping will be extended from 20 years to 25 years with chemical treatment which is the equivalent of 16 year and 20 year lives for analysis purposes.

CONSTRUCTION COST ESTIMATE		DATE: 23 SEPT 94	SHEET 1 OF 1
Project:	FORT GORDON ENERGY STUDY		
Location:	AUGUSTA, GEORGIA	**PROJ. NO.**	2
Arch/Engr:	HARRISON AND SPENCER, INC.	**CODE:**	BLDG 25330
Summary:	ECO #7 - TREAT MAKE-UP WATER	**Estimator:** H. TOUB	**Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
CHEMICAL FEED SYSTEM	1	LS	3500	3500	2500	2500	$6,000.00
TEST COUPON	1	LS	2000	2000	2000	2000	$4,000.00
	SUBTOTAL			5500		4500	
	5% SALES TAX			$275.00			
	17% LABOR TAX					$765.00	
	SUBTOTALS			$5,775.00		$5,265.00	$11,040.00
	20% OH (GC ONLY)						$2,208.00
	SUBTOTAL GC'S WORK						$13,248.00
	SUBTOTAL(GC & SUBS)						$13,248.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$662.40
	TOTAL						**$13,910.40**

ECO METHODOLOGY FORM

ECO NAME:	Replace Chillers 1 and 2 With High Efficiency Chillers
ECO NUMBER:	20
TYPE: BLDG SYSTEM:	Bldg. 25330 Cooling
EXISTING CONDITIONS:	See Figure 1B - Existing Chilled Water Schematic- Building 25330. Chillers 1 and 2 are the oldest chillers. Chillers 3 and 4 are the next in age. All chillers are 500 ton capacity.
PROPOSED CHANGE:	Replace two 500 ton Carrier chillers with two 450 ton high efficiency chillers. The two newer chillers numbers 3 and 4 shall remain in service.
CALCULATION & COST METHODOLOGY	The chiller load for the plant is determined by totaling the loads for the entire building on the chilled water distribution system and adding losses of the distribution piping. Table 1B shows the load for each hour and each month. Totalized tonnages are given in Table 2B. Required plant capacity is a percentage of the maximum calculated load of 1,600 tons shown in Table 3B. Table 3B shows how many hours per year the plant capacity will operate at a given tonnage range. New chiller sizes with best available efficiency are selected to best meet the expected plant loads. Cost and efficiency data were obtained from a representative of the chiller manufacturer. Cost of chiller is $112,000 for materials and $25,000 for labor for each of two chillers. New chillers will require less maintenance for a yearly savings of $2,000 per year.

ECO METHODOLOGY FORM

ECO NAME: Replace Chillers 1 and 2 With High Efficiency Chillers (Cont'd)

ECO NUMBER: 20

TYPE: BLDG Bldg. 25330
SYSTEM: Cooling

ENERGY SAVINGS
CALCULATIONS:

Existing Chillers 1 and 2:

% CAP	HRS	MBTU/HR	EER	KWHR
100%	367	12,000	22.4	196,607
80%	948	9,600	22.6	402,690
65%	1282	7,800	14.0	714,257
50%	6163	6,000	8.6	4,299,767
				5,613,321 KWH

@ $0.052/KWH
Annual Operating Cost = $291,893/yr

New Chiller:

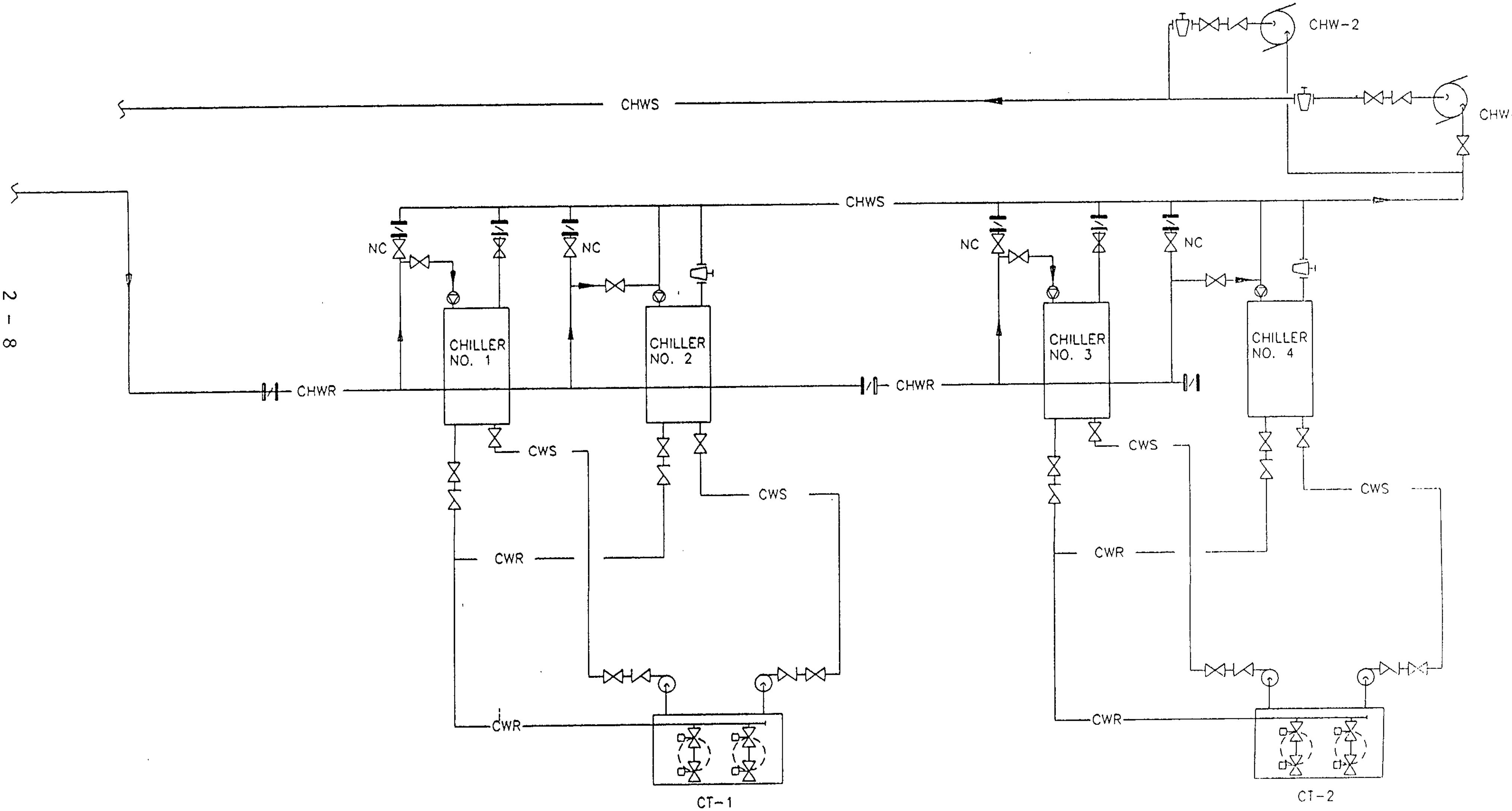
% CAP	HRS	TONS	KW/TON	KWH
100%	367	1,000	.58	212,860
80%	948	800	.53	401,952
65%	1282	650	.53	441,649
50%	6163	500	.52	1,602,380
				2,658,841 KWH

@ $0.052/KWH
Annual Operating Cost = $140,498/yr
Annual Savings = $151,395/yr

Annual Savings = 2,954,480 KWH

$$\frac{2,954,480 \times 3413}{10^6} = 10,083.6 \text{ Million Btu's}$$

Cost:
New Chillers $224,000 Labor $ 50,000



CHILLED WATER SCHEMATIC-BLDG. 25330

CONSTRUCTION COST ESTIMATE | **DATE:** 23 SEPT 94 | **SHEET 1 OF 1**

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA | **PROJ. NO.**

Arch/Engr: HARRISON AND SPENCER, INC. | **CODE:** BLDG 25330

Summary: ECO #20 - REPLACE CHILLERS | **Estimator:** H. TOUB | **Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
500 TON CHILLER	2	EA	112000	224000	25000	50000	$274,000.00
	SUBTOTAL			224000		50000	
	5% SALES TAX			$11,200.00			
	17% LABOR TAX					$8,500.00	
	SUBTOTALS			$235,200.00		$58,500.00	$293,700.00
	20% OH (GC ONLY)						$58,740.00
	SUBTOTAL GC'S WORK						$352,440.00
	SUBTOTAL(GC & SUBS)						$352,440.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$17,622.00
	TOTAL						**$370,062.00**

ECO METHODOLOGY FORM

ECO NAME:	Variable Speed Chilled Water Pumping
ECO NUMBER:	24
TYPE: BLDG SYSTEM:	Bldg. 25330 Cooling
EXISTING CONDITIONS:	This building has one chilled water loop with duplicate constant speed pumps circulating the water throughout this distribution loop. Buildings on the distribution loop all have 3-way valves and some have chilled water pumps within the building. The constant speed pumps have 350 horsepower motors, and the voltage used to drive them is 2300 volts.
PROPOSED CHANGE:	The existing pump motors will be removed and replaced with 480 volt motors. There will be a transformer added if necessary to convert the 2300 volts to 480 volts, then routed through a variable speed drive with switching to go to either one of the new motors for the existing pumps. Within each building on the distribution system, the 3-way valves will have the bypasses capped off so that they will operate as 2-way valves. See sketch and description in ECO 23 for Project No. 1. The chilled water pumps will be operated by the EMCS system on a schedule determined by EMCS operating personnel with their knowledge of all the building usages. The pump will come on and off as required to satisfy the space temperature conditions within the building, which will be monitored and controlled by the EMCS.

CALCULATION & COST METHODOLOGY

The cost estimate is as follows:

Secondary Pumps:			
Materials	$32,000	Labor	$ 4,000
20-inch piping			
Materials	$ 3,000	Labor	$ 1,500
Building controls and EMCS instrumentation			
Materials	$15,000	Labor	$15,000
One variable speed drive			
Material	$40,300	Labor	$ 1,500
One set of vacuum contractors			
Materials	$ 6,500	Labor	$ 1,000
One 2300 volt/480 volt transformer for 350 kva			
Materials	$11,200	Labor	$ 1,500
Two 350 horsepower 480 volt motors each at $17,700			
Materials	$35,400	Labor	$ 2,000
Piping changes within the buildings			
Materials	$14,000	Labor	$14,000
Building 25330 controls			
Materials	$ 3,000	Labor	$ 1,500
Electrical Work			
Materials	$ 4,000	Labor	$ 2,000

ECO METHODOLOGY FORM

ECO NAME:	Variable Speed Chilled Water Pumping (Cont'd)
ECO NUMBER:	24
TYPE: BLDG SYSTEM:	Bldg. 25330 Cooling
CALCULATION & COST METHODOLOGY:	

Savings will be obtained by determining the bins for which variable speed pumping will operate at each 10% increment, then apply this to a Bell & Gossett variable speed pumping program, which will determine the savings between constant speed with the same motors and drives with variable speed pumping and new motors, but the same pumps. The savings is the difference in KWH of 1,568,886.23 and 598,959.47 which is 969,926.73 KWH or

$$\frac{969{,}926.73}{10^6} \times 3413 = 3310.36 \text{ Million Btu's}$$

CONSTRUCTION COST ESTIMATE | **DATE:** 23 SEPT 94 | **SHEET 1 OF 1**

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA | **PROJ. NO.** 2

Arch/Engr: HARRISON AND SPENCER, INC. | **CODE:** BLDG 25330

Summary: ECO #24 - CHILLED WATER PUMPING | **Estimator:** H. TOUB | **Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
MATERIALS	4	EA	8000	32000	1000	4000	$36,000.00
PIPING	1	LS	3000	3000	1500	1500	$4,500.00
CONTROLS & EMCS INSTRUMENTATION	1	LS	15000	15000	15000	15000	$30,000.00
VARIABLE SPEED DRIVE	1	LS	40300	40300	1500	1500	$41,800.00
VACUUM CONTACTORS	1	LS	6500	6500	1000	1000	$7,500.00
TRANSFORMER	1	LS	11200	11200	1500	1500	$12,700.00
480 VOLT MOTOR	2	EA	17700	35400	2000	4000	$39,400.00
PIPING CHANGES	1	LS	14000	14000	14000	14000	$28,000.00
CONTROLS	1	LS	3000	3000	1500	1500	$4,500.00
ELECTRICAL WORK	1	LS	4000	4000	2000	2000	$6,000.00
	SUBTOTAL			164400		46000	
	5% SALES TAX			$8,220.00			
	17% LABOR TAX					$7,820.00	
	SUBTOTALS			$172,620.00		$53,820.00	$226,440.00
	20% OH (GC ONLY)						$45,288.00
	SUBTOTAL GC'S WORK						$271,728.00
	SUBTOTAL(GC & SUBS)						$271,728.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$13,586.40
	TOTAL						**$285,314.40**

B&G Pumping System Analysis:

SUMMARY OF INPUT DATA: 25330 cooling Pumps 1+2
System peak demand: 3840.00 gpm
System discharge pressure: 198.00 ft. (85.77 psig)
Minimum control/Static pressure: 25.00 ft. (10.83 psig)

Standard Efficiency (SE) 60-cycle motor.

1 Pump System:

Pump 1: Series VSCS 12X14X17.5L, Impeller diameter 14.875"
Design RPM = 1770.0, Motor HP = 300.00

CONSTANT SPEED OPERATION:

Hrs	Q/Qd,%	TGPM	TDH,ft	BHP	Ep,%	BHP/HP,m	HP,in	E,mtr,%	kWHR	$/day	E,w/w,%
3.90	10.0	384.0	221.5	220.03	9.8	0.733	229.91	95.7	668.6	26.75	9.3
6.53	20.0	768.0	221.5	220.03	19.5	0.733	229.91	95.7	1119.5	44.78	18.7
4.27	30.0	1152.0	221.0	220.03	29.2	0.733	229.91	95.7	732.1	29.28	28.0
2.18	40.0	1536.0	220.1	226.69	37.7	0.756	236.87	95.7	385.1	15.40	36.0
1.75	50.0	1920.0	218.6	236.53	44.8	0.788	247.15	95.7	322.5	12.90	42.9
1.59	60.0	2304.0	216.2	245.45	51.2	0.818	256.48	95.7	304.1	12.16	49.0
1.76	70.0	2688.0	213.4	253.73	57.1	0.846	265.13	95.7	348.0	13.92	54.6
0.84	80.0	3072.0	209.8	260.53	62.5	0.868	272.24	95.7	170.5	6.82	59.8
0.67	90.0	3456.0	205.7	266.69	67.3	0.889	278.84	95.6	139.3	5.57	64.4
0.51	100.0	3840.0	201.3	272.84	71.5	0.909	285.51	95.6	108.6	4.34	68.3

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COST SUMMARY:

Annual Operating Cost @ $0.04 / kwhr = $ 62755.45
8760 hours/year or 100.00%
Total annual operating cost = $ 62755.45
Total kW hours = 1568886.23

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VARIABLE SPEED OPERATION: (Table 1 of 1)

System suction pressure: 0.00 ft. (0.00 psig)
Best Efficiency Staging is ON

Hrs	Q/Qd,%	TGPM	TDH,ft	BHP	Ep,%	RPM	HP,in	E,d/m,%	kWHR	$/day	E,w/w,%
3.90	10.0	384.0	26.7	19.32	13.4	616.9	34.45	56.1	100.2	4.01	7.5
6.53	20.0	768.0	31.9	46.13	13.4	676.4	76.55	60.3	372.7	14.91	8.1
4.27	30.0	1152.0	40.6	40.08	29.4	772.5	61.36	65.3	195.4	7.81	19.2
2.18	40.0	1536.0	52.7	54.36	37.6	886.9	77.29	70.3	125.6	5.03	26.4
1.75	50.0	1920.0	68.3	74.06	44.7	1019.6	97.26	76.1	126.9	5.08	34.0
1.59	60.0	2304.0	87.3	99.47	51.1	1156.9	124.53	79.9	147.6	5.91	40.8
1.76	70.0	2688.0	109.8	130.63	57.0	1303.3	157.82	82.8	207.1	8.29	47.2
0.84	80.0	3072.0	135.7	168.72	62.4	1449.7	197.99	85.2	124.0	4.96	53.2
0.67	90.0	3456.0	165.1	214.37	67.2	1605.3	248.60	86.2	124.2	4.97	58.0
0.51	100.0	3840.0	198.0	268.44	71.5	1751.7	307.92	87.2	117.1	4.68	62.4

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Annual Operating Cost @ $0.04 / kwhr = $ 23958.38
8760 hours/year or 100.00%

Total kW hours = 598959.47

COST SUMMARY:

Suction Pressure   : 0.0 psig
Percent of Year   : 100%
Hours/Year   : 8760
Annual Operating Cost: $23958.38

Total hours/year   = 8760
Total annual operating cost = $23958.38

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ECO METHODOLOGY FORM

ECO NAME:	Controls For Supply CHW Regulation/Reset Temperature
ECO NUMBER:	30
TYPE: BLDG SYSTEM:	Bldg. 25330 Cooling
EXISTING CONDITIONS:	Although the chillers are set to maintain a constant chilled water supply temperature, the temperature actually varies because some water is bypassed through non-operating chillers. The system is set to operate at a constant supply water temperature of approximately 42°F.
PROPOSED CHANGE:	Wire the chilled water supply setpoint to existing EMCS controls so that the chilled water temperature setpoint can be used to vary the flow as required by the system load and the temperature reset be adjusted as conditions require. This will allow the temperature to vary upwards, and the savings of 1.5% of the chiller usage can be obtained for every 1° of reset temperature. Although the savings are available to be had, it is recommended that the ECO 24 in this Project no. 2, variable speed pumping, be implemented so that the temperature maintains the same 42°F. The variable flow to save energy is a better idea because each building will then have the full humidity control.

CALCULATION & COST METHODOLOGY

Total chiller usage is determined by the hours each bin of capacity is shown on Table 3A.

160 tons x 1152 hours x .75 =	138,240 KW hours
320 tons x 2536 hours x .75 =	608,640 KW hours
480 tons x 1680 hours x .75 =	604,800 KW hours
640 tons x 759 hours x .75 =	381,600 KW hours
800 tons x 671 hours x .75 =	402,600 KW hours
960 tons x 611 hours x .75 =	439,920 KW hours
1120 tons x 581 hours x .75 =	488,040 KW hours
1280 tons x 367 hours x .75 =	352,320 KW hours
1440 tons x 183 hours x .75 =	197,640 KW hours
1600 tons x 184 hours x .75 =	220,800 KW hours
	3,834,600 KW per year

For the available savings,

Multiply 1.5% of 3,834,600 x 50% for all temperatures above 43°F
Multiply 1.5% x 3,834,600 x 20% for all temperatures above 44°F
Multiply 3,834,600 x 10% for all temperatures above 45°F

Total = 46,015 KW or 157.05 Million Btu's per year.

Above 43°F	28759.5 KWH
Above 44°F	11503.8 KWH
Above 45°F	5 751.9 KWH
	46015.2 KWH x $\frac{3413}{10^6}$ = 157.05 Million Btu's/yr.

Cost:

Controls:

Materials	$5,000	Labor	$5,000

CONSTRUCTION COST ESTIMATE	DATE: 23 SEPT 94	SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY		
Location: AUGUSTA, GEORGIA		PROJ. NO.
Arch/Engr: HARRISON AND SPENCER, INC.		CODE: BLDG 25330
Summary: ECO #30 - TEMP RESET	Estimator: H. TOUB	Checked:

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
CONTROLS	1	LS	5000	5000	5000	5000	$10,000.00
	SUBTOTAL			5000		5000	
	5% SALES TAX			$250.00			
	17% LABOR TAX					$850.00	
	SUBTOTALS			$5,250.00		$5,850.00	$11,100.00
	20% OH (GC ONLY)						$2,220.00
	SUBTOTAL GC'S WORK						$13,320.00
	SUBTOTAL(GC & SUBS)						$13,320.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$666.00
	TOTAL						**$13,986.00**

ECO METHODOLOGY FORM

ECO NAME:	Common Manifolding of Cooling Towers
ECO NUMBER:	44
TYPE: BLDG SYSTEM:	Bldg. 25330 Cooling
EXISTING CONDITIONS:	All four chillers are 500 ton capacity and each is piped to its own cooling tower.
PROPOSED CHANGE:	Cross-connect cooling tower piping for maintenance work and to allow greater cooling tower capacity to reduce the approach to the ambient wet bulb temperature.
CALCULATION & COST METHODOLOGY:	Maintenance costs can be reduced by better maintenance scheduling. The life of the chillers is extended one year in 20 by allowing maintenance work to be accomplished when it is required not only when the chiller is available. Cooling tower life can also be extended for one year in twenty for the same reasons.

The efficiency of the chillers can be increased by 1% for every 2°F reduction in the condenser water temperature. For an average load on the chillers of 600 tons for five months the usage is:

600 tons x .78 KW/ton x 5 mo. x 30 days/mo x 24 hrs/day = 1,684,800 KW/yr.

At 1 % savings

.01 x 1,684,800 = 16,848 KW savings

$$16{,}848 \times \frac{3413}{10^6} = 57.5 \text{ Million Btu's/yr.}$$

Maintenance savings only - $2,000/yr

<u>Cost</u>:

Piping:

Material	$12,000	Labor	$10,000

The chiller energy savings is offset by the additional pumping cost of the condenser water. The cost of additional pumping is estimated at 21KW/hr for all the time the cooling tower is saving the 1%.

2KWH x 5 mo. x 30 days/mo. x 24 hrs/day = 7,200 KW/yr.

The net savings is therefore the difference of 16,848 - 7,200 = 9,648 KW

$$9{,}648\text{KW} \times \frac{3{,}413}{10^6} = 32.9 \text{ million BTU's/year}$$

CONSTRUCTION COST ESTIMATE	DATE: 23 SEPT 94	SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY		
Location: AUGUSTA, GEORGIA		**PROJ. NO.**
Arch/Engr: HARRISON AND SPENCER, INC.		**CODE:** 25330
Summary: ECO #44 - COMMON MANIFOLDING	**Estimator:** H. TOUB	**Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
PIPING MATERIALS	1	LS	12000	12000	10000	10000	$22,000.00
	SUBTOTAL			12000		10000	
	5% SALES TAX			$600.00			
	17% LABOR TAX					$1,700.00	
	SUBTOTALS			$12,600.00		$11,700.00	$24,300.00
	20% OH (GC ONLY)						$4,860.00
	SUBTOTAL GC'S WORK						$29,160.00
	SUBTOTAL(GC & SUBS)						$29,160.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$1,458.00
	TOTAL						**$30,618.00**

ECO METHODOLOGY FORM

ECO NAME:	Cooling Tower Water Treatment
ECO NUMBER:	48
TYPE: BLDG SYSTEM:	Bldg. 25330 Cooling
EXISTING CONDITIONS:	There is currently water treatment based on a conductivity meter of the cooling tower water, but biocide is added manually by the scoopful only as needed.
PROPOSED CHANGE:	This cooling tower chemical feed is adequate except for the method of feeding biocides. Proper maintenance and observation of the cooling towers is insufficient without the addition of new equipment. The equipment cost is $1,000 in materials and $300 for labor to measure and alarm when water is in need of treatment to reduce algea build-up.
CALCULATION & COST METHODOLOGY:	Because chemicals are now being added, there is no increased cost of chemicals. Any improvements in the cooling water chemical treatment will be positive and can reduce maintenance by $2,000/year total. The life of the cooling tower is extended for two years so that with treatment the life of the cooling tower is 20 years, but without treatment it is 18 years. The cost of a new cooling tower is $18,000 in materials and $3,600 in labor for each of four towers in Building 25330 for a total of 21,600 x 4 = $86,400. The efficiency improvements of the chillers will be 1% of the yearly chiller operating cost of 3,834,600KW per year as shown in ECO No. 30. This savings is 3,834,600KW x 1% x $\frac{3,413}{10^6}$ = 130.87 million BTU's/yr.

CONSTRUCTION COST ESTIMATE	DATE: 31 JAN 95	SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY		
Location: AUGUSTA, GEORGIA		PROJ. NO. 2
Arch/Engr: HARRISON AND SPENCER, INC.		CODE: BLDG 25330
Summary: ECO #48 COOLING TOWER WATER TREATM	Estimator: H. TOUB	Checked:

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
CHEMICAL FEED	1	LS	1,000	1000	300	300	$1,300.00
	SUBTOTAL			1000		300	
	5% SALES TAX			$50.00			
	17% LABOR TAX					$51.00	
	SUBTOTALS			$1,050.00		$351.00	$1,401.00
	20% OH (GC ONLY)						$280.20
	SUBTOTAL GC'S WORK						$1,681.20
	SUBTOTAL(GC & SUBS)						$1,681.20
	10% GC'S PROFIT						
	5% CONTINGENCY						$84.06
	TOTAL						**$1,765.26**

ECO METHODOLOGY FORM

ECO NAME:	Chilled Water Storage
ECO NUMBER:	54
TYPE: BLDG SYSTEM:	Bldg. 25330 Cooling

EXISTING CONDITIONS: From Table 2B in ECO 20, the highest available tonnage at any particular time is in June at 1700 hours where the load gets up to 1543.3 tons for that hour. This high rate occurs when the maximum demand at the base occurs and will cause the electric bill to be based on a higher demand.

PROPOSED CHANGE: Provide an aboveground chilled water storage tank with a capacity equal to approximately 450,000 gallons. This will supply 3,100 ton hours of cooling, which will allow the chiller to operate at a maximum of 900 tons throughout the summer. During the month of June the calculated tonnage is as follows:

HOUR	TONNAGE COMPUTED		STORAGE (Tonnage - 900) COMPUTATION
1400	960.1		60.1
1500	994.9		94.9
1600	999.6		99.6
1700	1543.3		643.3
1800	1486.2		586.2
1900	1376.4		476.4
2000	1378.3		378.3
2100	1176.8		276.8
2200	1119.2		219.2
2300	1058.2		158.2
2400	983.1		83.1
		Total	3076.1

The aboveground storage tank is sized based on chilled water 42°F, using it until it gets to 52°F with 10° Δt. Therefore 1,200 pounds of water is required per ton hour.

$$\frac{3{,}076.1 \text{ ton hrs} \times 1{,}200 \text{ lbs/ton hr}}{8.34 \text{ lbs/gal}} = 442{,}604 \text{ gal. required}$$

$$\frac{3{,}076.1 \text{ ton hrs.} \times 1{,}200 \text{ lbs/ton hr.}}{62.4 \text{ lbs/cu. ft.}} = 59{,}156 \text{ cu. ft. required}$$

Rough sizing of the tank to try to make the diameter equal to the height results in a diameter of 44 ft. and a height of 39 ft. Piping will be shown as depicted in the sketch included with the Project No. 2 write-up.

CALCULATION & COST METHODOLOGY: The cost of a 3,100 ton hour chilled water storage at $60/ton hr. is $186,000

Material	$146,000	Labor	$40,000

Savings is computed based on demand savings, which is $106.20/KW/Yr. for demand reduction. Since there is an interruptible rate effective at Fort Gordon, there is an additional $45/KW they will receive for reducing demand during the peak period, which is the purpose of the chilled water storage. Therefore, the total amount saved is $151.20/KW of demand. The peak chilling capacity occurs in June and is 1,543.3 tons. If the chiller generated capacity is limited to 900 tons, this would save 643.3 tons.

643.3 tons x .78 KW/ton = 501.77 KW demand savings
501.77 x $151.20 = $75,868.23 savings in demand

CONSTRUCTION COST ESTIMATE	DATE: 23 SEPT 94	SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY		
Location: AUGUSTA, GEORGIA		PROJ. NO. 2
Arch/Engr: HARRISON AND SPENCER, INC.		CODE: BLDG 25330
Summary: ECO #54 - CHILLED WATER STORAGE	Estimator: H. TOUB	Checked:

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
UNDERGROUND CHILLED WATER STORAGE TANK	1	LS	146000	146000	40000	40000	$186,000.00
	SUBTOTALS 1			$146,000.00		$40,000.00	$186,000.00
	5% SALES TAX			$7,300.00			$7,300.00
	17% LABOR TAX					$6,800.00	$6,800.00
	SUBTOTALS 2			$153,300.00		$46,800.00	$200,100.00
	20% GC OH & PROFIT						$40,020.00
SUB-CONTRACTORS	SUBTOTAL GC WORK						$240,120.00
	TOTAL SUB WORK						
	10% GC SUB PROFIT						
	5% CONTINGENCY ON JOB						$12,006.00
	TOTAL						$252,126.00

ECO METHODOLOGY FORM

ECO NAME:	EMCS Controls for Chilled Water South System
ECO NUMBER:	87
TYPE: BLDG SYSTEM:	Bldg. 25330 Cooling

EXISTING CONDITIONS:

Existing automatic or manual controls that are within the plant are not remotely operable by the EMCS by design. The EMCS office which is manned 24 hours a day has very few, if any, instrumentation readouts from the plant, and no control of the plant with the EMCS. Because EMCS personnel are aware of what is happening in many buildings, they are also aware of conditions and demands in the chilled water system. Currently, the boiler operators are making boiler pressure changes, HTW changes, bringing on and off chillers, cooling towers, and many manual valving operations. However, they are not performing the functions that an EMCS office can to control energy and to improve the operating efficiency of the plant.

PROPOSED CHANGE:

New equipment installed in other ECO's in this Project No. 2 shall be connected to the EMCS system for instrumentation readout and for control of equipment, pumps, etc.

Required EMCS Controls and Instrumentation for the Chilled Water System at Building 25330

DESCRIPTION	POINTS	AMOUNT
Chiller efficiency software	10	$10,000
Flow meter and temperatures at distribution pipe locations	8	10,000
Operating controls for chiller pumps, condenser pumps, etc.	8	4,000
Temperatures for chilled water, condenser water, etc.	8	1,600
Chiller amps	4	2,000
Variable speed and switch controls		1,600
Pressures for chilled water return, supply and storage	6	1,800
		$31,000

CALCULATION & COST METHODOLOGY:

The cost of the equipment is as shown in the Proposed Change above. The cost estimate sheet is based on percentages of estimates used in ECO 86 of Project No. 1 to arrive at labor rates. These are additional costs only to wire the existing controls to the new controls identified in other ECO's. The only thing that is not included in other ECO's is the distribution system flow meters and temperature sensors because that did not work out as a viable ECO for Project No. 2 as it did for Project No. 1. Those flow meters and temperature sensors in the distribution pipe will be included in this ECO.

Savings: Hours per year operating at 900 tons of chiller capacity of 49 hours based on Table 2B in ECO 20. The remaining hours in the year the average load is 400 tons/hr.
49 x 30 days/mo. = 1,470 hrs/yr. x 900 tons x .78 KW/ton = 1,031,940 KWH

(8,760 - 1470) hours per year x 400 tons avg. x .76 KW/ton = 2,274,480 KWH
Total = 3,306,420 KWH

3,306,420 KWH x $.052/KW = $171,933.84 x .03 = $5,158.02

$$\frac{3{,}306{,}420\text{ KWH} \times .03 \times 3{,}413}{10^6} = 338.54\text{ Million Btu's/yr.}$$

This is the savings obtained by 3% improvement in the operating efficiency of the chillers.

CONSTRUCTION COST ESTIMATE				DATE: 11 JAN 95		SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY						
Location: AUGUSTA, GEORGIA				PROJ. NO. 2		
Arch/Engr: HARRISON AND SPENCER, INC.				CODE: BLDG 25330		
Summary: ECO #87 - EMCS CONTROLS	Estimator: H. TOUB			Checked:		

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
CHILLER EFFIENCY SOFT WARE	1	LS			10000	10000	$10,000.00
FLOW METER & TEMP DISTRIBUTION SYSTEM	1	LS	6500	6500	3500	3500	$10,000.00
PUMP OPERATING CONTROLS	1	LS	2500	2500	1500	1500	$4,000.00
TEMPERATURES	1	LS	600	600	1000	1000	$1,600.00
CHILLER AMPS	1	LS	1000	1000	1000	1000	$2,000.00
VARIABLE SPEED & SWITCH CONTROL	1	LS	600	600	1000	1000	$1,600.00
PRESSURES - CHW, SUPPLY, RETURN AND STOR	1	LS	900	900	900	900	$1,800.00
	SUBTOTALS 1			$12,100.00		$18,900.00	$31,000.00
	5% SALES TAX			$605.00			$605.00
	17% LABOR TAX					$3,213.00	$3,213.00
	SUBTOTALS 2			$12,705.00		$22,113.00	$34,818.00
	20% GC OH & PROFIT						$6,963.60
SUB-CONTRACTORS	SUBTOTAL GC WORK						$41,781.60
	TOTAL SUB WORK						
	10% GC SUB PROFIT						
	5% CONTINGENCY ON JOB						$2,089.08
	TOTAL						$43,870.68

COOLING PROFILE BUILDING 25330

JANUARY

DAY HOUR	BUILDING TYPE														
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1		0.7			15.3											16.7
2					12.1											12.1
3					9.7											9.7
4					7.6											7.6
5					116.0											116.0
6					133.4											133.4
7					144.8											144.8
8					153.0											153.0
9					159.3				4.0							167.3
10					164.5				10.2							184.9
11					168.8				12.4			1.0	0.4			196.0
12					172.4				14.4			4.2	3.9			213.5
13					175.3				16.0			4.6	4.6			221.1
14				0.9	177.6				17.2			6.1	5.1			233.8
15	0.9			1.4	179.5				18.4		1.3	7.6	5.4			249.7
16	1.6			1.5	184.6			4.0	19.2		2.6	7.9	5.5		0.3	272.8
17	14.1			1.5	187.4			7.4	19.3		1.9	7.7	2.2		0.9	345.5
18	15.0			1.4	83.1			6.1	18.7		1.2	6.4	1.2		0.1	230.7
19	15.0			1.2	66.9				7.2	1.2	0.4	5.4	0.5			175.2
20	14.1			1.1	56.2	5.4			4.9			4.6				183.6
21	13.4	3.8		0.2	37.4	5.2			3.1							150.4
22	12.0	12.2			31.1	5.0	4.0		1.4							208.3
23	11.1	11.5			24.2	4.6	3.3		0.2							180.2
24	10.0	10.8			19.0	4.4	2.4									153.0

FEBRUARY

DAY HOUR	BUILDING TYPE														
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1		2.4			15.5											26.3
2	1.2				12.5											12.5
3					9.9											9.9
4					7.8											7.8
5					116.3											116.3
6					133.5											133.5
7					144.7											144.7
8					152.7											152.7
9					158.9				4.6							168.1
10					164.1				9.5							183.1
11					168.5				11.4			0.4				192.1
12					172.0				13.2			3.8	3.5			209.5
13				0.3	174.9				15.1			4.4	4.4			219.8
14				1.1	177.4				16.6			5.2	4.9			231.4
15	0.4			1.2	179.5				17.9			7.5	5.4			243.7
16	1.4			1.4	181.0			0.3	18.4		0.8	7.9	5.5			254.5
17	14.5			1.5	183.2			7.2	18.6		1.7	7.9	2.2		0.1	335.3
18	16.5			1.5	84.4			7.0	18.4	1.5	1.2	7.4	1.4		0.2	245.7
19	16.4			1.4	68.0	0.3		1.1	7.2	1.4	0.6	6.2	0.6			190.4
20	16.2			1.3	56.6	5.9			4.9			5.5	0.1			200.4
21	16.0	16.0		0.4	42.1	5.9	7.2		3.1							305.7
22	15.5	15.9		0.1	32.4	5.9	6.5		1.7							278.5
23	15.1	15.8			25.3	5.7	5.9		0.7							256.5
24	14.3	15.2			19.3	5.6	5.2									232.8

TABLE 1B

MARCH

DAY HOUR	BUILDING TYPE															
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	8.8	7.5			16.9	2.0	1.3		0.7							108.8
2	5.5	4.1			12.9	0.9										54.0
3	3.2	1.9			10.3											30.1
4	1.7				8.3											16.8
5					117.1											117.1
6					134.5											134.5
7					145.7				0.2							146.1
8	0.8				153.8				8.9							175.6
9	2.4				160.2				10.4							193.0
10	4.1				165.5				12.1			1.6				213.4
11	6.4			1.0	169.9				14.4			5.6	4.2	0.3		246.9
12	7.9			1.6	173.6				16.8			7.7	5.3	0.7		270.1
13	8.8			1.8	178.7			10.7	18.6		0.2	9.7	6.0	1.7	1.5	309.9
14	10.5			2.0	190.3			13.6	20.4	4.4	4.4	10.8	6.7	2.7	2.3	351.2
15	11.4			2.2	191.2			14.6	21.3	3.5	2.2	11.5	6.9	3.4	2.5	359.7
16	12.8		4.3	2.4	191.1			15.5	21.7	3.3	2.1	11.9	7.1	3.9	2.7	375.0
17	26.2	21.2	4.0	2.5	191.2			16.0	21.9	4.4	1.9	12.1	3.3		2.8	487.4
18	27.9	26.1	3.5	2.5	95.3	6.5	13.8	15.7	21.7	4.1	1.5	11.5	2.5		1.4	652.4
19	27.4	26.2	2.7	2.3	80.3	9.3	14.7	6.7	9.5	3.7	1.2	10.2	1.7		0.8	617.9
20	26.8	26.1	2.0	2.3	69.7	9.4	14.3	4.2	7.1	1.2	0.4	9.2	1.1		0.4	582.9
21	25.7	25.5	1.3	0.9	46.1	9.4	13.5	2.3	5.4	0.7	0.1	2.3	0.7		0.1	511.1
22	25.2	25.4	0.7	0.6	35.5	9.5	12.7	1.2	3.9	0.3		1.3	0.3			476.6
23	23.9	24.8	0.2	0.4	27.8	9.1	11.8		2.7			0.4				436.9
24	22.2	23.4		0.2	21.8	8.5	10.7		1.7							395.5

APRIL

DAY HOUR	BUILDING TYPE															
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	15.8	11.9	0.7	0.4	18.5	3.7	4.9	0.8	0.7	0.3		0.7				224.4
2	13.2	8.4	0.3	0.3	14.6	2.6	2.9									158.3
3	10.8	6.1		0.2	11.3	1.7	1.6									112.7
4	9.3	4.1			8.7	0.9	0.3									73.3
5	7.8	2.4			118.8	0.3										164.4
6	7.0	1.3			136.2											173.8
7	6.6	0.7			147.4				0.2							182.2
8	7.7	1.5			155.7				8.9							215.0
9	8.9	2.4		0.8	162.1			0.7	10.4			0.8		2.3		241.5
10	11.8	4.2		1.7	169.7			11.7	12.1			6.4	3.1	3.4		312.5
11	13.6	5.3	0.9	2.1	178.9		1.3	14.6	14.4			9.7	5.2	5.6	2.5	396.6
12	15.1	5.5	4.3	2.4	188.5	1.0	3.4	16.9	16.8	5.5		11.5	6.4	7.2	3.0	481.8
13	16.4	5.8	5.4	2.6	196.3	1.1	3.8	18.6	18.6	7.8	3.3	12.6	7.4	10.0	3.5	528.0
14	18.2	6.6	6.4	2.9	203.8	1.6	4.8	20.7	20.4	9.0	4.4	13.6	8.0	13.2	4.0	586.5
15	20.8	8.0	7.4	3.1	196.2	2.3	6.6	22.7	21.3	5.1	2.5	14.6	8.5	14.7	4.4	635.1
16	21.6	7.9	7.6	3.2	194.8	2.5	7.1	23.1	21.7	4.7	2.3	14.8	8.4	15.2	4.4	648.7
17	38.5	30.8	5.5	3.3	194.6	10.6	20.1	23.3	21.9	6.1	2.1	14.9	3.9	3.4	4.5	1007.5
18	38.4	35.9	5.1	3.3	105.7	12.4	22.5	22.8	21.7	5.9	1.8	14.6	3.1	3.3	2.3	953.7
19	37.8	36.8	4.4	3.1	90.7	12.8	21.9	11.4	9.5	5.5	1.5	13.2	2.3	2.8	1.6	871.6
20	37.2	36.7	3.5	3.0	79.9	12.9	20.6	8.0	7.1	2.3	0.8	12.0	1.7	2.1	1.1	814.1
21	37.3	36.9	2.8	1.3	48.3	12.9	20.5	6.0	5.4	1.7	0.6	4.6	1.2	1.6	0.7	745.5
22	36.3	37.0	2.2	1.0	36.9	12.6	19.5	4.2	3.9	1.3	0.3	3.4	0.8	1.1	0.5	698.2
23	34.8	35.3	1.6	0.7	29.1	12.3	18.1	3.0	2.7	1.0	0.1	2.6	0.5	0.4	0.3	645.1
24	32.4	33.7	1.1	0.6	23.2	11.5	16.4	1.8	1.7	0.6	0.0	1.6	0.3		0.1	583.6

TABLE 1B

MAY

DAY HOUR	BUILDING TYPE															
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	21.2	15.2	1.8	0.7	19.6	5.1	7.6	3.4	2.1	1.0	0.2	2.7	0.5	1.4	0.3	327.8
2	20.0	11.7	1.4	0.5	15.6	4.0	5.6	2.4	1.3	0.8		1.8	0.3	0.9	0.2	265.5
3	17.3	9.1	1.0	0.4	12.4	3.0	4.0	1.4	0.6	0.4		1.1	0.1	0.3	0.0	205.1
4	15.0	7.3	0.6	0.3	9.6	2.2	2.8	0.7		0.2		0.3			0.0	158.7
5	13.0	5.6	0.3	0.2	119.1	1.5	1.6					0.1			0.0	229.8
6	11.1	4.2		0.1	136.9	1.0	0.5								0.0	214.8
7	12.1	4.7	0.2	0.2	149.0	0.9	1.2		7.5						0.0	258.5
8	13.6	5.4	0.9	0.3	161.8	1.1	2.2	6.7	11.3	0.1		0.3			0.0	319.3
9	14.6	5.9	1.9	1.3	171.6	1.3	3.1	10.7	12.9	1.2		7.6	2.3	5.4	2.1	407.2
10	16.7	7.9	3.4	1.9	175.9	1.8	4.9	14.9	14.7	1.9		10.0	4.8	9.7	2.6	488.8
11	19.0	8.9	5.0	2.4	179.5	2.2	5.9	17.8	16.9	2.6		11.8	5.9	12.4	3.2	550.5
12	21.0	9.0	6.4	2.8	194.0	2.4	6.2	20.5	18.9	7.4	2.1	13.4	7.0	14.8	3.9	612.9
13	23.2	9.4	7.8	3.1	204.5	2.5	6.6	23.5	20.8	9.4	4.5	15.0	8.1	18.2	4.6	672.2
14	26.8	10.2	9.0	3.6	213.2	3.0	7.7	26.6	22.2	11.0	5.9	16.3	9.1	21.6	5.3	748.3
15	30.2	11.6	10.4	4.0	199.2	3.6	9.4	29.0	23.5	6.4	3.3	17.4	9.6	22.4	5.7	793.5
16	30.6	12.2	11.0	4.1	197.8	4.1	10.2	29.7	23.8	5.9	3.0	17.9	9.7	22.5	5.8	814.6
17	48.2	40.4	7.0	4.2	197.0	13.8	26.4	29.8	23.9	7.7	2.9	18.1	4.4	6.4	5.8	1237.0
18	48.3	46.5	0.7	4.2	115.7	16.0	28.9	30.1	23.7	7.7	2.7	17.8	3.7	6.1	3.0	1188.8
19	48.0	47.0	6.1	4.1	101.4	16.2	28.6	15.3	11.1	7.4	2.4	16.7	3.0	5.7	2.2	1110.5
20	47.6	47.4	5.1	3.9	93.3	16.2	27.1	10.9	8.4	3.5	1.4	15.0	2.3	4.9	1.7	1048.7
21	49.5	49.2	4.5	1.8	50.4	16.8	27.6	8.7	6.6	2.6	1.0	6.9	1.8	4.2	1.3	989.0
22	47.0	48.0	3.8	1.3	38.3	16.3	26.0	6.9	5.1	2.2	0.7	5.6	1.4	3.5	1.1	919.2
23	44.5	44.7	3.2	1.0	30.4	15.3	23.8	5.6	4.1	1.8	0.6	4.6	1.1	2.7	0.8	840.5
24	41.8	42.9	2.6	0.8	24.4	14.5	22.1	4.4	3.0	1.4	0.4	3.6	0.8	2.1	0.6	775.8

JUNE

DAY HOUR	BUILDING TYPE															
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	29.5	18.2	3.1	0.9	20.5	6.2	9.8	5.5	3.2	1.7	0.5	4.3	1.0	3.8	0.8	435.6
2	30.1	14.6	2.7	0.7	16.7	5.0	7.8	4.6	2.5	1.4	0.4	3.5	0.8	3.1	0.6	381.3
3	27.1	12.3	2.3	0.6	13.4	4.2	6.2	3.6	1.8	1.1	0.3	2.8	0.6	2.6	0.5	322.0
4	24.9	10.2	2.0	0.5	10.7	3.3	5.1	2.8	1.1	0.9	0.1	2.1	0.4	2.1	0.3	274.3
5	22.7	8.5	1.7	0.4	121.4	2.6	3.8	2.2	0.5	0.6		1.7	0.2	1.7	0.2	341.1
6	22.0	7.4	1.5	0.4	139.7	2.2	3.0	1.8		0.5		1.4	0.1	1.3	0.1	335.3
7	23.5	7.6	3.9	0.4	163.0	2.2	3.7	2.6	10.7	0.5	0.2	1.3	0.2	1.5	0.3	404.3
8	25.4	8.6	5.3	0.6	179.5	2.4	4.9	13.7	12.7	1.8	0.4	2.6	0.6	1.8	3.1	507.3
9	27.4	10.0	6.8	2.3	191.4	2.7	5.9	20.9	14.4	2.5	0.7	11.2	4.8	21.5	4.3	628.3
10	31.1	11.5	8.6	3.3	181.5	3.3	7.9	25.4	16.4	3.3	1.2	13.8	7.0	23.5	4.8	708.0
11	32.8	12.5	10.0	3.8	183.9	3.6	8.9	28.2	18.0	4.1	1.8	15.9	8.4	25.3	5.5	764.8
12	34.7	12.7	11.3	4.1	212.6	3.8	9.2	30.6	20.1	11.1	6.4	17.5	9.3	27.3	6.1	843.4
13	36.1	13.1	12.4	4.3	222.5	4.0	9.6	32.4	21.9	13.1	7.9	18.9	10.2	29.2	6.6	890.7
14	39.6	13.7	14.2	4.8	230.1	4.4	10.4	35.4	23.7	14.5	9.6	20.0	11.0	32.3	7.3	960.1
15	43.5	15.2	16.0	5.2	202.8	5.0	12.1	38.2	25.2	7.9	4.5	21.2	11.6	35.1	7.8	994.9
16	42.4	15.3	15.7	5.2	200.3	5.5	13.0	37.9	25.7	7.2	3.9	21.3	11.5	33.8	7.6	999.6
17	62.3	54.1	9.1	5.3	200.0	18.4	34.4	38.4	26.0	9.7	3.7	21.5	5.0	9.0	7.8	1543.3
18	59.5	60.7	8.5	5.3	129.9	20.7	36.7	38.1	26.1	9.9	3.5	21.2	4.3	8.8	3.8	1486.2
19	59.9	59.8	7.8	5.1	117.0	20.5	35.6	18.7	12.4	9.5	3.2	19.9	3.6	8.5	2.9	1376.4
20	57.6	58.4	6.8	4.8	105.4	19.7	33.5	13.5	9.8	4.5	1.9	17.9	2.9	7.3	2.2	1278.3
21	58.3	58.8	6.0	2.1	52.0	19.8	33.2	10.8	7.8	3.5	1.5	8.6	2.3	6.3	1.8	1176.8
22	56.8	58.6	5.2	1.6	39.4	19.6	31.9	9.2	6.5	2.9	1.1	7.2	1.9	5.6	1.5	1119.2
23	55.1	56.3	4.7	1.2	31.4	18.9	30.4	7.7	5.2	2.4	0.9	6.2	1.6	5.1	1.3	1058.2
24	52.2	54.3	4.0	1.1	25.4	18.0	28.1	6.6	4.2	2.0	0.7	5.2	1.3	4.3	1.1	983.1

TABLE 1B

JULY

DAY HOUR	BUILDING TYPE															
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	28.3	17.2	2.9	0.8	20.2	5.7	8.7	4.8	4.6	1.5	0.4	3.7	0.8	3.2	0.7	405.4
2	29.8	14.0	2.5	0.7	16.3	4.6	7.0	3.9	3.8	1.2	0.3	3.1	0.6	2.7	0.6	363.1
3	27.1	11.4	2.2	0.5	13.2	3.8	5.7	3.1	3.1	1.0	0.2	2.6	0.5	2.2	0.4	309.2
4	24.8	9.7	2.0	0.5	10.6	3.0	4.4	2.4	2.4	0.8	0.1	2.0	0.3	1.8	0.3	261.5
5	23.8	8.1	1.7	0.4	121.7	2.4	3.4	2.1	1.9	0.6		1.5	0.2	1.4	0.2	340.8
6	23.1	7.0	1.6	0.3	140.1	2.0	2.6	1.5	1.4	0.4		1.2	0.1	1.2	0.1	334.4
7	24.2	6.9	4.3	0.4	165.8	1.9	3.3	2.3	13.1	0.4	0.2	1.0	0.2	1.4	0.3	405.2
8	27.1	8.3	6.3	0.5	184.4	2.2	4.4	14.3	16.0	1.7	0.4	2.2	0.5	1.7	3.4	521.0
9	29.4	9.4	7.9	2.3	196.2	2.5	5.7	22.1	18.3	2.4	0.8	11.1	4.8	24.6	4.7	655.1
10	32.7	11.0	9.7	3.5	182.6	3.1	7.5	26.7	20.4	3.3	1.3	14.4	7.6	26.0	5.2	729.2
11	34.8	12.0	11.1	4.0	184.6	3.4	8.6	29.2	22.3	4.2	1.9	16.2	8.6	27.6	5.8	787.2
12	37.0	12.3	12.7	4.3	218.2	3.6	8.9	31.9	24.1	11.9	6.5	17.7	9.7	30.7	6.5	875.3
13	37.9	12.3	13.8	4.6	228.6	3.8	8.8	33.7	25.6	14.0	8.3	18.9	10.5	32.1	7.0	911.6
14	39.6	12.5	14.6	4.8	232.6	4.1	9.7	35.2	27.2	14.8	8.9	19.8	11.0	33.2	7.3	955.0
15	41.1	13.8	15.4	5.0	202.7	4.6	11.1	36.7	28.9	7.8	4.5	20.5	11.4	33.7	7.5	959.9
16	41.1	13.6	15.5	5.1	200.0	5.0	11.5	37.0	29.2	6.9	4.0	20.5	11.3	34.1	7.5	965.9
17	60.1	49.8	8.7	5.1	199.6	17.0	31.8	36.7	29.3	9.1	3.6	20.2	4.6	7.7	7.4	1469.5
18	57.1	58.5	7.9	5.1	127.6	20.1	35.2	36.3	29.5	9.3	3.3	20.0	3.9	7.6	3.5	1435.8
19	58.6	58.0	7.2	5.0	116.9	19.7	34.1	17.5	14.0	9.0	3.0	18.7	3.2	7.2	2.6	1331.4
20	56.4	57.2	6.2	4.7	103.5	19.5	32.5	12.4	11.0	4.2	1.8	16.8	2.5	6.2	2.1	1246.0
21	56.0	56.9	5.4	2.0	51.4	19.1	31.2	9.5	9.2	3.2	1.3	7.7	2.0	5.6	1.7	1121.7
22	54.1	55.0	4.7	1.4	38.9	18.6	30.0	8.1	7.6	2.6	1.0	6.4	1.7	4.9	1.4	1058.3
23	51.4	53.0	4.1	1.2	30.9	17.7	28.0	6.7	6.3	2.1	0.8	5.4	1.3	4.3	1.2	985.1
24	50.6	52.2	3.5	1.0	24.9	17.2	26.8	5.8	5.3	1.8	0.6	4.5	1.1	3.7	0.9	941.6

AUGUST

DAY HOUR	BUILDING TYPE															
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	30.5	17.6	3.1	0.8	20.4	6.0	9.0	5.0	4.1	1.5	0.5	4.0	0.9	3.4	0.8	425.1
2	30.8	14.0	2.8	0.7	16.4	4.7	7.3	4.2	3.3	1.2	0.4	3.3	0.7	2.9	0.6	374.0
3	27.8	11.8	2.4	0.6	13.4	3.9	5.7	3.4	2.8	1.0	0.3	2.7	0.5	2.4	0.5	316.3
4	25.6	9.7	2.1	0.5	10.7	3.1	4.6	2.7	2.2	0.8	0.2	2.1	0.3	1.7	0.3	269.7
5	23.6	8.5	1.8	0.4	121.7	2.6	3.7	2.0	1.7	0.6		1.6	0.2	1.3	0.2	345.9
6	22.1	7.0	1.6	0.3	139.8	2.0	2.9	1.5	1.4	0.4		1.2	0.1	1.1	0.1	333.5
7	21.9	6.4	3.5	0.3	162.3	1.8	2.8	1.6	13.0	0.3	0.2	0.5		0.9	0.1	374.8
8	24.0	7.5	4.9	0.4	178.9	2.0	3.9	12.3	16.6	1.4	0.3	1.5	0.3	1.0	2.9	478.3
9	26.9	8.6	6.4	2.1	190.8	2.4	5.1	19.3	18.9	2.1	0.6	10.3	4.4	21.4	4.1	608.6
10	28.8	10.6	7.8	3.1	181.1	2.8	6.9	23.6	20.9	3.0	1.1	13.4	6.7	21.2	4.5	673.7
11	30.2	11.3	9.0	3.5	183.4	3.2	7.8	26.1	22.8	3.9	1.7	15.2	8.1	23.1	5.1	725.5
12	32.6	11.7	10.7	3.9	211.6	3.4	8.1	28.8	24.7	10.8	5.6	16.8	9.2	26.2	5.8	808.9
13	35.2	11.6	12.6	4.2	224.4	3.5	8.3	31.6	26.5	13.2	7.5	18.2	10.3	29.5	6.5	867.8
14	37.7	12.3	13.9	4.6	229.8	4.0	9.2	33.7	27.7	14.3	8.4	19.3	11.0	31.1	6.9	923.2
15	41.0	13.7	15.4	4.9	202.6	4.6	11.0	36.2	28.6	7.8	4.5	20.5	11.5	33.7	7.4	954.8
16	41.7	14.3	16.0	5.1	200.1	5.1	11.8	37.0	29.1	7.1	4.0	20.9	11.6	33.1	7.5	976.1
17	60.7	51.6	9.1	5.2	200.0	17.6	33.1	37.2	29.0	9.4	3.8	20.8	4.9	7.9	7.5	1503.9
18	59.0	60.8	8.3	5.3	131.9	20.7	36.4	37.4	28.8	9.6	3.5	20.4	4.00	7.8	3.6	1480.4
19	59.2	58.8	7.4	5.0	118.7	19.8	34.4	17.4	13.7	9.0	3.1	18.7	3.30	7.2	2.6	1342.5
20	57.7	58.7	6.5	4.8	107.2	19.9	33.2	12.3	10.4	4.1	1.8	17.2	2.60	6.4	2.0	1271.7
21	58.0	59.2	5.7	2.0	51.7	19.8	32.7	10.0	8.6	3.2	1.3	8.1	2.10	5.7	1.7	1164.4
22	57.2	58.3	5.1	1.5	39.1	19.4	31.5	8.3	7.0	2.6	1.0	6.8	1.8	5.1	1.4	1109.1
23	54.5	56.5	4.5	1.2	31.1	18.5	29.6	7.2	6.0	2.2	0.8	5.7	1.5	4.4	1.2	1038.4
24	52.5	54.5	3.9	1.0	25.2	17.7	27.9	6.0	5.0	1.8	0.7	4.9	1.2	3.9	1.0	977.7

TABLE 1B

SEPTEMBER

DAY HOUR	BUILDING TYPE															
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	22.8	14.8	1.9	0.6	19.6	4.8	7.0	3.2	3.9	1.0	0.3	2.6	0.6	1.5	0.4	327.9
2	23.4	11.4	1.6	0.5	15.7	3.8	5.1	2.4	3.0	0.7	0.1	2.0	0.4	0.8	0.2	277.3
3	19.9	9.2	1.2	0.4	12.5	2.8	3.8	1.6	2.3	0.4		1.3	0.1	0.3	0.0	218.6
4	18.2	7.2	0.9	0.3	9.9	2.1	2.5	0.8	1.7	0.2		0.8			0.0	174.6
5	15.7	5.5	0.6	0.2	120.0	1.6	1.7		1.1			0.2			0.0	248.8
6	14.2	4.5	0.3	0.1	137.7	0.8	0.8		0.5			0.1			0.0	236.5
7	13.2	3.3	0.6		152.4	0.5			11.3						0.0	251.2
8	15.2	4.3	1.5	0.2	165.6	0.8	1.4	6.0	13.9						0.0	318.3
9	16.9	5.5	2.6	1.4	177.7	1.2	2.7	12.7	16.0	1.0		6.5	2.5	9.9	2.8	436.7
10	19.6	7.0	4.3	2.2	178.1	1.5	4.0	16.9	18.1	1.9		10.3	5.0	14.7	3.1	511.4
11	21.5	7.7	5.9	2.8	181.5	1.8	4.9	20.2	20.5	2.7	0.8	12.5	7.0	16.7	3.9	573.4
12	23.2	8.5	7.4	3.1	200.1	2.1	5.4	22.7	23.1	8.4	4.4	14.3	8.2	18.7	4.5	645.5
13	25.3	8.6	8.7	3.4	209.7	2.3	5.9	24.8	25.0	10.3	5.8	15.7	9.1	20.4	5.0	698.0
14	28.6	9.7	10.4	3.8	218.7	2.8	7.2	27.5	27.1	11.8	7.1	17.3	10.1	21.8	5.6	774.7
15	31.5	10.4	11.7	4.1	199.8	3.2	8.3	30.0	28.3	6.4	4.1	18.2	10.5	24.8	6.1	801.6
16	33.4	10.9	12.5	4.3	197.9	3.7	9.4	31.2	28.8	6.0	3.7	18.9	10.6	25.6	6.2	837.2
17	51.9	42.8	7.7	4.4	197.9	14.4	27.3	31.2	28.8	7.9	3.5	18.7	4.6	6.3	6.3	1298.7
18	49.7	49.8	6.9	4.4	121.4	17.2	29.7	30.7	28.6	7.8	3.1	17.6	3.7	5.9	2.9	1244.6
19	50.7	49.5	5.8	4.2	109.6	16.8	28.1	13.5	13.6	7.5	2.6	15.9	2.9	5.1	2.0	1131.3
20	51.1	51.2	5.2	4.2	100.7	17.4	28.4	9.8	10.7	3.2	1.5	15.2	2.3	4.3	1.6	1110.7
21	50.9	51.5	4.5	1.7	50.6	17.3	27.9	7.8	8.7	2.6	1.1	6.6	1.8	3.9	1.3	1009.4
22	48.8	49.8	3.8	1.2	38.2	16.7	26.2	6.5	7.1	2.0	0.8	5.5	1.5	3.3	1.1	939.4
23	46.7	47.1	3.3	0.9	30.4	15.8	24.6	5.2	5.9	1.7	0.6	4.5	1.2	2.6	0.8	873.4
24	44.2	45.5	2.7	0.8	24.4	14.9	22.5	4.1	4.8	1.3	0.4	3.6	0.9	2.1	0.6	804.5

OCTOBER

DAY HOUR	BUILDING TYPE															
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	10.3	8.3		0.1	17.0	2.2	1.5		1.2							123.7
2	7.2	4.9			13.0	1.0			0.4							65.6
3	5.4	2.4			10.4	0.1										42.8
4	3.5	0.8			8.3											27.4
5	2.4				117.8											129.8
6	1.1				135.2											140.7
7	1.1				146.4				2.3							156.5
8	2.5				154.7				10.1							187.4
9	4.8				161.4				11.8					0.7		209.7
10	7.0				166.8				14.2			2.6	0.8	2.9		239.1
11	8.8			1.8	171.3				17.0			6.8	4.9	2.2		279.0
12	10.7			2.0	177.7			10.2	19.3			10.2	6.3	2.8	2.0	345.7
13	11.6			2.2	194.2			15.9	21.2	3.0	3.4	11.3	7.2	3.9	2.9	400.7
14	13.1		2.3	2.4	198.7			16.5	22.5	8.1	4.6	12.2	7.6	4.7	3.2	431.5
15	14.4	2.1	5.6	2.5	194.2			17.5	23.5	4.2	2.8	12.8	7.8	5.2	3.3	442.5
16	15.0	4.1	5.8	2.6	193.2			17.6	23.8	3.8	2.5	13.2	7.7	4.8	3.2	448.8
17	28.0	24.3	4.2	2.6	192.5	1.1	4.5	17.2	23.6	4.7	2.1	12.7	3.5	0.0	3.1	614.5
18	28.4	25.5	3.3	2.5	97.8	9.3	15.2	15.8	22.9	4.2	1.7	11.2	2.4	0.9	1.4	710.6
19	29.4	27.7	2.6	2.4	84.5	10.1	15.4	6.4	10.5	3.9	1.2	10.2	1.7	0.5	0.8	661.0
20	31.3	29.8	1.8	2.4	73.9	10.7	15.7	4.1	7.8	1.3	0.5	9.5	1.2		0.5	653.3
21	29.8	29.4	1.2	0.9	46.9	10.5	14.9	2.6	6.1	0.8	0.1	2.4	0.7		0.2	572.3
22	28.1	28.3	0.7	0.6	35.9	10.0	13.8	1.2	4.6	0.4		1.4	0.3			518.8
23	26.7	27.1	0.3	0.4	28.1	9.6	12.8		3.2			0.4				474.9
24	25.6	26.0		0.2	22.0	9.0	11.5		2.1							433.7

TABLE 1B

NOVEMBER

DAY HOUR	BUILDING TYPE															
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	9.2	7.3			16.8	1.8	0.9		1.0			0.0				103.7
2	6.0	4.0			13.0	0.6										54.6
3	3.6	1.5			10.4											31.4
4	1.7				8.3											16.8
5	0.6				117.7											120.7
6					134.7											134.7
7					145.9				0.8							147.5
8					153.9				9.2							172.3
9	0.6				160.3				10.5							184.3
10	2.6				165.7				12.8							204.3
11	4.0				170.2				15.1			4.7	3.2			233.0
12	5.6			1.5	173.8				17.4			6.9	5.1	0.8		263.8
13	7.5			1.7	178.5			2.2	19.3		2.1	9.2	5.9	2.0	0.8	302.3
14	9.5			1.9	191.7			13.1	20.9	3.2	4.5	10.3	6.5	3.1	2.3	373.0
15	11.4			2.2	191.4			14.3	22.2	3.4	2.5	11.3	7.1	3.9	2.6	392.7
16	12.3		3.2	2.3	191.3			15.2	23.0	3.1	2.3	11.8	7.3	4.2	2.8	406.8
17	24.6	1.1	3.4	2.3	191.0			14.8	22.8	4.0	2.0	11.3	3.1		2.7	459.6
18	25.2	22.9	2.6	2.2	95.5			13.6	22.1	3.7	1.5	10.1	2.2		1.0	387.9
19	25.4	23.7	2.0	2.2	82.2	8.5	9.9	5.0	9.9	6.4	1.0	9.4	1.5		0.6	531.4
20	26.8	25.7	1.4	2.2	72.0	9.3	13.0	2.9	7.3	0.9	0.3	8.9	1.0		0.3	563.4
21	27.5	26.9	0.9	0.7	46.2	9.5	12.8	1.6	5.8	0.6	0.1	2.0	0.6		0.1	511.8
22	26.0	26.3	0.4	0.5	35.5	9.2	12.3	0.4	4.3	0.2		1.0	0.3			472.6
23	25.0	25.5		0.3	27.8	8.8	11.5		3.1			0.1				437.0
24	23.2	23.6		0.1	21.8	8.3	10.5		2.1							397.0

DECEMBER

DAY HOUR	BUILDING TYPE															
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	3.9	4.0			15.8	0.4										45.7
2	0.9	1.0			12.6											19.1
3					10.1											10.1
4					8.1											8.1
5					117.2											117.2
6					134.4											134.4
7					145.6											145.6
8					153.7				2.9							159.5
9					160.1				9.6							179.3
10					165.4				11.8							189.0
11	1.0				169.9				13.9			2.2	1.6			208.7
12	2.5				173.5				16.2			4.8	4.6			232.6
13	3.5			1.2	176.6				18.0			7.1	5.4	0.7		256.4
14	4.3			1.7	181.7			0.9	19.6		3.8	8.8	6.0	1.2		281.3
15	5.3			1.8	190.7			11.3	20.6		2.7	9.2	6.3	1.4		318.8
16	6.0			1.9	190.3			11.3	21.4	0.3	2.3	9.6	6.3	1.4	0.6	329.5
17	18.2			1.9	189.5			10.5	21.1	3.4	1.8	9.0	2.5		1.9	394.1
18	19.0			1.7	88.2			9.3	20.4	2.7	1.2	7.7	1.5		1.8	286.3
19	19.3			1.6	71.7	2.7		2.1	8.6	2.2	0.6	6.9	0.9		1.8	245.7
20	19.1	18.0		1.5	59.8	6.8	3.2		6.1	0.1		6.4	0.4		0.5	317.1
21	19.0	18.3		0.4	43.6	6.7	8.1		4.3							347.5
22	18.3	18.0		0.2	33.5	6.7	7.6		2.8							321.8
23	17.8	18.0			25.9	6.6	7.1		1.6							300.2
24	17.0	17.6			20.1	6.3	6.5		0.6							276.8

TABLE 1B

TONNAGE PROFILE BY MONTH

DAY HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	16.7	26.3	108.8	224.4	327.8	435.6	405.4	425.1	327.9	123.7	103.7	45.7
2	12.1	12.5	54.0	158.3	265.5	381.3	363.1	374.0	277.3	65.6	54.6	19.1
3	9.7	9.9	30.1	112.7	205.1	322.0	309.2	316.3	218.6	42.8	31.4	10.1
4	7.6	7.8	16.8	73.3	158.7	274.3	261.5	269.7	174.6	27.4	16.8	8.1
5	116.0	116.3	117.1	164.4	229.8	341.1	340.8	345.9	248.8	129.8	120.7	117.2
6	133.4	133.5	134.5	173.8	214.8	335.3	334.4	333.5	236.5	140.7	134.7	134.4
7	144.8	144.7	146.1	182.2	258.5	404.3	405.2	374.8	251.2	156.5	147.5	145.6
8	153.0	152.7	175.6	215.0	319.3	507.3	521.0	478.3	318.3	187.4	172.3	159.5
9	167.3	168.1	193.0	241.5	407.2	628.3	655.1	608.6	436.7	209.7	184.3	179.3
10	184.9	183.1	213.4	312.5	488.8	708.0	729.2	673.7	511.4	239.1	204.3	189.0
11	196.0	192.1	246.9	396.6	550.5	764.8	787.2	725.5	573.4	279.0	233.0	208.7
12	213.5	209.5	270.1	481.8	612.9	843.4	875.3	808.9	645.5	345.7	263.8	232.6
13	221.1	219.8	309.9	528.0	672.2	890.7	911.6	867.8	698.0	400.7	302.3	256.4
14	233.8	231.4	351.2	586.5	748.3	960.1	955.0	923.2	774.7	431.5	373.0	281.3
15	249.7	243.7	359.7	635.1	793.5	994.9	959.9	954.8	801.6	442.5	392.7	318.3
16	272.8	254.5	375.0	648.7	814.6	999.6	965.9	976.1	837.2	448.8	406.8	329.5
17	345.5	335.3	487.4	1007.5	1237.0	1543.3	1469.5	1503.9	1298.7	614.5	459.6	394.1
18	230.7	245.7	652.4	953.7	1188.8	1486.2	1435.8	1480.4	1244.6	710.6	387.9	286.3
19	175.2	190.4	617.9	871.6	1110.5	1376.4	1331.4	1342.5	1131.3	661.0	531.4	245.7
20	183.6	200.4	582.9	814.1	1048.7	1278.3	1246.0	1271.7	1110.7	653.3	563.4	317.1
21	150.4	305.7	511.1	745.5	989.0	1176.8	1121.7	1164.4	1009.4	572.3	511.8	347.5
22	208.3	278.5	476.6	698.2	919.0	1119.2	1058.3	1109.1	939.4	518.8	472.6	321.8
23	180.2	256.5	436.9	645.1	840.5	1058.2	985.1	1038.4	873.4	474.9	437.0	300.2
24	153.0	232.8	395.5	583.6	775.8	983.1	941.6	977.7	804.5	433.7	397.0	276.8

Table 2B

BUILDING 25330 PLANT COOLING SUMMARY				
CAPACITY TONS	% PLANT CAPACITY	BIN LIMIT–TONS	HOURS PER BIN	HOURS PER REP DAY
1600	10	160	1152	3.16
	20	320	2536	6.95
	30	480	1680	4.60
	40	640	795	2.18
	50	800	671	1.84
	60	960	611	1.67
	70	1120	581	1.59
	80	1280	367	1.01
	90	1440	183	0.50
	100	1600	184	0.50

Table 3B

ROWLAND
01!Fort Gordon
P1CARLTON SHUFORD
P2DSN 780-6376
P3ATZH-DIC-E
/RECALL F 000045554 S 03 ECIP PROJECT 2: UPGRADE CHILLER PLANT BUILDING 25330, FT. GORDON

03A !DESCRIPTION OF PROPOSED CONSTRUCTION

***Upgrade chillers, accessories and the chilled water distribution system at the Central Utility Plant, South side of the Ft. Gordon Installation. Several innovative modifications to the central chilled water system are required to meet current and future cooling requirements for all building on the northern half of the facility. Replacement of obsolete equipment with new high efficiency systems will reduce energy requirements significantly while increasing the net cooling capacity for the barracks, classrooms and administrative buildings.

03B !REMARKS

***This Energy conservation measure to replace the existing chilled water system consists of eight ECO's, which were combined to create one comprehensive ECIP. Each ECO was developed from field studies of the South Side Central Utility Plant. The economics of incorporating all ten ECO's is explained in the economic justification section of this document. The ten ECO's are described below to provide extra insight into the comprehensive approach taken.

ECO NO.	DESCRIPTION
7	Chilled Water Chemical Treatment
20	Replace Chillers
24	Variable Speed Pumping System
30	Temperature Reset System
44	Cooling Tower Manifold
48	Condenser Water Chemical Treatment
54	Chilled Water Storage System
87	EMCS Controls and Instrumentation

ECO DATA COMPILATION

ECO NO.	DESCRIPTION	COST (FROM LCC)	SAVINGS 1ST YEAR	TOTAL DISCOUNT SAVINGS
7	Chem Treatment-CHW	15,510	17,000	361,040
20	Chiller Replacement	412,620	155,632	2,427,680
24	Variable Speed Pumping	318,126	50,436	787,309
30	CHW Temperature Reset	15,596	2,393	37,351
44	Cooling Tower Manifold	34,139	3,037	48,033
48	Condenser Water Chemical Treat.	1,968	4,167	64,061
54	Chilled Water Storage	281,121	75,868	1,118,298
87	EMCS Controls & Instrumentation	48,917	5,158	80,516
	Totals	1,127,997	313,691	4,924,288

Simple Payback: $\frac{1,127,997}{313,691} = 3.64$

SIR: $\frac{4,924,288}{1,127,997} = 4.37$

03C !PROJECT DESCRIPTION

***This Energy conservation measure provides the plan to design the required upgrade to the Central Utility Plant, South. Removal and replacement of five inefficient chillers with three new ones properly sized to provide incremental increase in the chilled water capacity as the site load varies. The five old chillers being replaced include 3-700 ton units and 2-750 ton units for a combined capacity of 3,600 tons. The three new chillers have capacity of 1-400 ton chiller and 2-1,250 ton chillers for a combined total of 2,900 tons. The new units are sized to match the load change throughout the day, and have the capacity to replenish the chilled water storage system at night. The chilled water storage system will provide the capacity to make up the difference between the older units 3,600 tons and the capacity of the newer unit of 2,900 tons, or 700 tons. Since the peak demand for chilled water occurs over a short t period of time, the chilled water storage system will provide a capacity to meet a peak demand of 4,400 tons of refrigeration. This exceeds current demand by 800 tons and allows for less chiller capacity to meet current and future needs. Repiping of both the chilled water system and condenser water system will provide flexibility in selecting equipment to run. Current piping makes manual selection of equipment difficult and requires excessive manpower to change over as site loads vary. Consequently, it is easier for chilled water to run through all chillers than to try to control valves and pumps to meet load requirements. In addition to providing a new efficient piping design that is easy to operate, variable speed pumps will be introduced to further allow for energy efficient operation under all load conditions. With the addition of instrumentation and control, all chilled water control functions could be handled from a central location reducing the need for plant operators by fifty percent.

03D !REQUIREMENT (Why is it needed now)

****The chilled water system is not meeting current cooling requirements for the buildings served on the north side of the facility. New construction and renovations will increase the capacity on this system to meet current and future requirements. New CFC regulations for chiller refrigerants will require replacement of older chillers, and require system redesign of chilled water distribution by 1997.

If not implemented now, cooling capacity will not meet current or future needs.

03E !CURRENT SITUATION (How is the need currently being met)

***ECO 7

The existing chemical treatment system serves the condenser side of the chilled water system and is feeding a C-6220 chemical from Industrial Maintenance Corporation into the condenser water system. Additionally an A-102 microbicide is added to each cooling tower by the bucket as the algae begins to build up in the cooling towers. There is no chemical feed on the chilled water side of the system. Since there is a fairly large volume of make-up water to the chilled water side, water that is fed into the system is not treated water at this time, nor is there any way to treat the water with the present equipment.

ECO 20

See Figure 1B - Existing Chilled Water Schematic- Building 25330. Chillers 1 and 2 are the oldest chillers. Chillers 3 and 4 are the next in age. All chillers are 500 ton capacity.

ECO 24

This building has one chilled water loop with duplicate constant speed pumps circulating the water throughout this distribution loop. Buildings on the distribution loop all have 3-way valves and some have chilled water pumps within the building. The constant speed pumps have 350 horsepower motors, and the voltage used to drive them is 2300 volts.

ECO 30

Although the chillers are set to maintain a constant chilled water supply temperature, the temperature actually varies because some water is bypassed through non-operating chillers. The system is set to operate at a constant supply water temperature of approximately 42°F.

ECO 44

All four chillers are 500 ton capacity and each is piped to its own cooling tower.

ECO 48

There is currently water treatment based on a conductivity meter of the cooling tower water, but biocide is added manually by the scoopful only as needed.

ECO 54

From Table 2B in ECO 20, the highest available tonnage at any particular time is in June at 1700 hours where the load gets up to 1543.3 tons for that hour. This high rate occurs when the maximum demand at the base occurs and will cause the electric bill to be based on a higher demand.

ECO 87

Existing automatic or manual controls that are within the plant are not remotely operable by the EMCS by design. The EMCS office which is manned 24 hours a day has very few, if any, instrumentation readouts from the plant, and no control of the plant with the EMCS. Because EMCS personnel are aware of what is happening in many buildings, they are also aware of conditions and demands in the chilled water system. Currently, the boiler operators are making boiler pressure changes, HTW changes, bringing on and off chillers, cooling towers, and many manual valving operations. However, they are not performing the functions that an EMCS office can to control energy and to improve the operating efficiency of the plant.

03F !IMPACT IF NOT PROVIDED

***If this project is not accomplished, Fort Gordon will continue to use excessive energy to supply chilled water to the buildings on the north side of the facility. Because of old inefficient chillers and a distribution system that does not respond to reduced load conditions, all equipment must run all the time to provide adequate cooling. The existing system requires high electrical consumption at all times and high demand for electricity during the entire cooling season.

03G !ADDITIONAL

***Not Applicable

03I !RELATED PROJECTS

***ECIP - 45553 - Chilled Water System to Central Utility Plant - Building 25330 North Side

ECIP - 45555 - High Temperature Water Systems North Plant - Building 25910

ECIP - 45556 - High Temperature Water System South Plant - Building 25330
/*

07A !GENERAL JUSTIFICATION DATA

***This ECIP project is required to support the Army wide effort to reduce energy consumption. The project will reduce energy consumption by upgrading the chilled water system at the Central Plant South, Building 25330, Ft. Gordon. The project will replace two old inefficient 500 ton chillers with two new high efficiency chillers, replace two 2300 volt pumps with new 480 volt pumps and add variable speed driver. In addition, new control instrumentation will allow connection to the existing EMCS system.

The project has been coordinated with the installation physical security plan and no security improvements are required.

The project includes eight ECO's combined to provide a comprehensive upgrade to the facility chilled water system. The following overview lists the ECO's along with the economic justification.

PROJECT NO. 2 - CHILLED WATER SOUTH

ECO DATA COMPILATION

ECO NO.	DESCRIPTION	CONSTRUCTION COST	ANNUAL RECURRING COST	NON-RECURRING DISCOUNTED COST (-) SAVINGS (+)	COST (From LCC)	ELECTRICAL SAVINGS MMBTU/YR	NAT GAS SAVINGS MMBTU/YR	DEMAND SAVINGS $	SAVINGS 1st YEAR	TOTAL DISCOUNT SAVINGS
7	Chem Treatment-CHW	13,910.40	-4,000	420,000	15,510	0	0	0	17,000	361,040
20	Chiller Replacement	370,062.00	2,000	0	412,620	1,008.60	0	0	155,632	2,427,680
24	Variable Speed Pumping	285,314.40	0	0	318,126	3,310.36	0	0	50,436	787,309
30	CHW Temperature Reset	13,986.00	0	0	15,596	157.05	0	0	2,393	37,351
44	Cooling Tower Manifolding	30,618.00	2,000	10,728	34,139	32.9	0	0	3,037	48,033
48	Condenser Water Chemical Treatment	1,765.26	2,000	3,456	1,968	130.87	0	0	4,167	64,061
54	Chilled Water Storage	252,126.00	0	0	281,121	0	0	75,868	75,868	1,118,298
87	EMCS Controls and Instrumentation	43,870.68	0	0	48,917	338.54	0	0	5,158	80,516
	Totals	1,011,652.70	2,000	434,184	1,127,997	14,053.32	0	75,868	313,691	4,924,288

Simpler Payback: $\frac{1,127,997}{313,691} = 3.60$ years

SIR: $\frac{4,924,288}{1,127,997} = 4.37$

07B !TRAFFIC ANALYSIS

*** There will be no changes to pedestrian or vehicular traffic as a result of implementing this ECIP.
/*

08B !PRESENT ACCOMMODATIONS AND DISPOSITION

***The physical plant building 25330 housing the chilled water system is adequate to accommodate the new chillers, once the old chillers are removed. The chilled water storage tank will be located outside in a vacant field adjacent to the cooling towers.
/*

09D !RPMA DISCUSSION

***This ECIP will reduce the amount of Real Property Maintenance Required.
/*

10A !ANALYSIS OF DEFICIENCIES

***1) Chemical treatment of makeup water not being performed on the chilled water due to large amount of makeup water required.
2) Existing constant speed pumping system is not able to adjust chilled water flow to meet air conditioning load changer. The pumps run continuously so more water is circulated than requiring during off peak load condition. Energy is wasted as a result of the pumping costs.
3) The chillers and the chilled water system is currently run manually. There is little instrumentation to assist the operator in scheduling equipment to run at reduced load. Running the plant is labor intensive and susceptible to inefficient operation.
4) Excessive makeup water requirements make water treatment impractical and costly. Water losses need to be reduced dramatically.
5) All chillers run during peak A/C load condition. Excessive use of electricity causes high demand conditions to exist. These peak loads occur over a relatively short period of time during peak summer conditions.
6) Two of the four chillers are at the end of their useful life. They are very inefficient and do not meet the requirements to eliminate CFC refrigerant.
/*

11D !DECISION ANALYSIS

***The following is a detailed cost breakdown of each of the ECO's. Refer to the table in 7A General Justification Data which summarizes these costs.

ECO 7 - LCCA

1.	Investment		
	A.	Construction Cost	$ 13,910.00
	B.	SIOH	$ 765.00
	C.	Design Cost	$ 835.00
	D.	Total Cost (1A + 1B + 1C)	$ 15,510.00
2.	Energy Savings		$ -5,994.00
3.	Non Energy Savings		$ 361,040.00
4.	First Year Dollar Savings		$ 17,000.00
5.	Simple Payback Period		$ 1.10 Years
6.	Total Net Discounted Savings		$ 361,040
7.	Savings to Investment Ratio		$ 23.28

ECO 20 - LCCA

1.	Investment		
	A.	Construction Cost	$ 370,062.00
	B.	SIOH	$ 20,354.00
	C.	Design Cost	$ 22,204.00
	D.	Total Cost (1A + 1B + 1C)	$ 412,620.00
2.	Energy Savings		$ 4,090.00
3.	Non Energy Savings		$ 29,480.00
4.	First Year Dollar Savings		$ 155,632.00
5.	Simple Payback Period		$ 2.65 Years
6.	Total Net Discounted Savings		$ 2,427,680.00
7.	Savings to Investment Ratio		$ 5.88

ECO 24 - LCCA

1.	Investment		
	A.	Construction Cost	$ 285,314.00
	B.	SIOH	$ 15,693.00
	C.	Design Cost	$ 17,119.00
	D.	Total Cost (1A + 1B + 1C)	$ 318,126.00
2.	Energy Savings		$ -2,684.00
3.	Non Energy Savings		$ 0.00
4.	First Year Dollar Savings		$ 50,436.00
5.	Simple Payback Period		$ 6.31 Years
6.	Total Net Discounted Savings		$ 787,309.00
7.	Savings to Investment Ratio		$ 2.47

ECO 30 - LCCA

1.	Investment		
	A. Construction Cost	$	13,986.00
	B. SIOH	$	770.00
	C. Design Cost	$	840.00
	D. Total Cost (1A + 1B + 1C)	$	15,596.00
2.	Energy Savings	$	-5,837.00
3.	Non Energy Savings	$	0.00
4.	First Year Dollar Savings	$	2,393.00
5.	Simple Payback Period	$	6.52 Years
6.	Total Net Discounted Savings	$	37,351.00
7.	Savings to Investment Ratio	$	2.39

ECO 44 - LCCA

1.	Investment		
	A. Construction Cost	$	30,618.00
	B. SIOH	$	1,684.00
	C. Design Cost	$	1,837.00
	D. Total Cost (1A + 1B + 1C)	$	34,139.00
2.	Energy Savings	$	-5,961.00
3.	Non Energy Savings	$	40,208.00
4.	First Year Dollar Savings	$	3,037.00
5.	Simple Payback Period	$	11.24 Years
6.	Total Net Discounted Savings	$	48,033.00
7.	Savings to Investment Ratio	$	1.41

ECO 48 - LCCA

1.	Investment		
	A. Construction Cost	$	1,765.00
	B. SIOH	$	97.00
	C. Design Cost	$	106.00
	D. Total Cost (1A + 1B + 1C)	$	1,968.00
2.	Energy Savings	$	-5,863.00
3.	Non Energy Savings	$	32,936.00
4.	First Year Dollar Savings	$	4,167.00
5.	Simple Payback Period	$	.47 Years
6.	Total Net Discounted Savings	$	64,061.00
7.	Savings to Investment Ratio	$	32.55

ECO 54 - LCCA

1.	Investment		
	A. Construction Cost	$	252,126.00
	B. SIOH	$	13,867.00
	C. Design Cost	$	15,128.00
	D. Total Cost (1A + 1B + 1C)	$	281,121.00
2.	Energy Savings	$	-5,994.00
3.	Non Energy Savings	$	0.00
4.	First Year Dollar Savings	$	75,868.00
5.	Simple Payback Period	$	3.71 Years
6.	Total Net Discounted Savings	$	1,118,298.00
7.	Savings to Investment Ratio	$	3.98

ECO 87 - LCCA

1.	Investment		
	A. Construction Cost	$	43,871.00
	B. SIOH	$	2,413.00
	C. Design Cost	$	2,633.00
	D. Total Cost (1A + 1B + 1C)	$	48,917.00
2.	Energy Savings	$	-5,655.00
3.	Non Energy Savings	$	0.00
4.	First Year Dollar Savings	$	5,158.00
5.	Simple Payback Period	$	9.48 Years
6.	Total Net Discounted Savings	$	80,516.00
7.	Savings to Investment Ratio	$	1.65

11E !ECONOMIC ANALYSIS
***ECO 7

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Chemical Feed System	1	LS	3,500	3,500	2,500	2,500	$6,000.00
Test Coupon	1	LS	2,000	2,000	2,000	2,000	$4,000.00
					SUBTOTAL		$11,040.00
					20% OH (GC ONLY)		$2,208.00
					SUBTOTAL GC'S WORK		$13,248.00
					SUBTOTAL (GC & SUBS)		$13,248.00
					5% CONTINGENCY		$662.40
					TOTAL		$13910.40

ECO 20

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
500 Ton Chiller	2	EA	112,000	224,000	25,000	50,000	$274,000.00

SUBTOTAL	$293,700.00
20% OH (GC ONLY)	$58,740.00
SUBTOTAL GC'S WORK	$352,440.00
SUBTOTAL (GC & SUBS)	$352,440.00
5% CONTINGENCY	$17,622.00
TOTAL	$370,062.00

ECO 24

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Materials	4	EA	8,000	32,000	1,000	4,000	$36,000.00
Piping	1	LS	3,000	3,000	1,500	1,500	$4,5000.00
Controls & EMCS Instr.	1	LS	15,000	15,000	15,000	15,000	$30,000.00
Variable Speed Drive	1	LS	40,300	40,300	1,500	1,500	$41,800.00
Vacuum Contractors	1	LS	6,500	6,500	1,000	1,000	$7,500.00
Transformer	1	LS	11,200	11,200	1,500	1,500	$12,700.00
480 Volt Motor	2	EA	17,700	35,400	2,000	4,000	$39,400.00
Piping Changes	1	LS	14,000	14,000	14,000	14,000	$28,000.00
Controls	1	LS	3,000	3,000	1,500	1,500	$4,500.00
Electrical Work	1	LS	4,000	4,000	2,000	2,000	$6,000.00

SUBTOTAL	$226,440.00
20% OH (GC ONLY)	$45,288.00
SUBTOTAL GC'S WORK	$271,728.00
SUBTOTAL (GC & SUBS)	$271,7280.00
5% CONTINGENCY	$13,586.40
TOTAL	$285,314.40

ECO 30

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Controls	1	LS	5,000	5,000	5,000	5,000	$10,000.00

SUBTOTAL	$11,100.00
20% OH (GC ONLY)	$2,220.00
SUBTOTAL GC'S WORK	$13,320.00
SUBTOTAL (GC & SUBS)	$13,320.00
5% CONTINGENCY	$666.00
TOTAL	$13,986.00

ECO 44

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Piping Materials	1	LS	12,000	12,000	10,000	10,000	$22,000.00

SUBTOTAL	$24,300.00
20% OH (GC ONLY)	$4,860.00
SUBTOTAL GC'S WORK	$29,160.00
SUBTOTAL (GC & SUBS)	$29,160.00
5% CONTINGENCY	$1,458.00
TOTAL	$30,618.00

ECO 47

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Chemical Feed	1	LS	1,000	1,000	300	300	$1,300.00

SUBTOTAL	$1,401.00
20% OH (GC ONLY)	$280.20
SUBTOTAL GC'S WORK	$1,681.20
SUBTOTAL (GC & SUBS)	$1,681.20
5% CONTINGENCY	$84.06
TOTAL	$1,765.26

ECO 54

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Underground Chilled Water Storage Tank	1	LS	146,000	146,000	40,000	40,000	$186,000.00

SUBTOTAL 1	$186,000.00
5% SALES TAX	$7,300.00
17% LABOR TAX	$6,800.00
SUBTOTAL 2	$200,100.00
20% GC OH & PROFIT	$40,020.00
SUBTOTAL GC WORK	$240,120.00
5% CONTINGENCY	$12,006.00
TOTAL	$252,126.00

ECO 53

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Chiller Efficiency Soft Ware	1	LS			10,000	10,000	$20,000.00
Flow Meter & Temp Dist. Sys.	1	LS	6,500	6,500	3,500	3,500	$10,000.00
Pump Operating Controls	1	LS	2,500	2,500	1,500	1,500	$4,000.00
Temperatures	1	LS	600	600	1,000	1,000	$1,600.00
Chiller Amps	1	LS	1,000	1,000	1,000	1,000	$2,000.00
Variable Speed & Switch Ctrl.	1	LS	600	600	1,000	1,000	$1,600.00
Pressures-CHW, Supply Return and Storage	1	LS	900	900	900	900	$1,800.00
					SUBTOTAL 1		$31,000.00
					5% SALES TAX		$605.00
					17% LABOR TAX		$3,213.00
					SUBTOTAL 2		$34,818.00
					20% GC OH & PROFIT		$6,963.60
					SUBTOTAL GC WORK		$41,781.60
					5% CONTINGENCY		$2,089.08
					TOTAL		$43,870.68

/*

12A !CRITERIA FOR PROPOSED CONSTRUCTION

***Construction will conform to existing guidelines of architectural design and building construction, specifically the AEI Design Guide (March 1987), the Corps of Engineers Guide Specifications CEGS 13947 thru 13949 for EMCS, and TM 5-812-2.

13B !FURNISHINGS AND EQUIPMENT DISCUSSION

***1) Two chillers will be replaced with 2 new chillers.
2) Two variable speed pump driver will be added.
3) Rerouting of existing pipes to permit better control.
4) New sensors and controls will automate operation.
5) Chilled water storage tank to be added.
/*

15A !ENVIRONMENTAL DOCUMENTATION

***The refrigerant in four old chillers will need to be reclaimed. Permits will be required. The refrigerants have market value and can be disposed of by selling at current market value. There are no other environmental issues.

15B1 !SUMMARY OF ENVIRONMENTAL CONSEQUENCES

***We have reviewed this project and determined that an environmental impact statement, pursuant to PL

91-190, is not required. We have assessed this project and determined that it will not contribute significantly to air and/or water pollution.
/*

16A1 !EVALUATION OF FLOOD HAZARDS

***The renovation is to an existing plant. No history of flooding has been recorded.
/*

19A !SUMMARY OF ENERGY REQUIREMENTS

***The existing electric utility system in adequate to support the modifications, upgrades and new equipment recommendations. No changes will be required to meet the requirements and modifications. Peak load requirements will actually be reduced. Equipment operation will reflect the changing load requirements throughout the day allowing chillers and pumps to be scheduled more efficiently, thus reducing electric consumption and demand.

The engineering study reports electric consumption reduction to be 15,586,741 KWH and a demand reduction of 2,981.78 from first order effects to reducing equipment use, and chilled water storage.

19B !SUMMARY OF UTILITY SUPPORT

***The central utility plant connected load will be reduced by 15%. The existing electric utilities supplied to the central plant is adequate and will not require additional capacity to be added.

20B !HAZARDS TO HANDICAPPED PERSONS

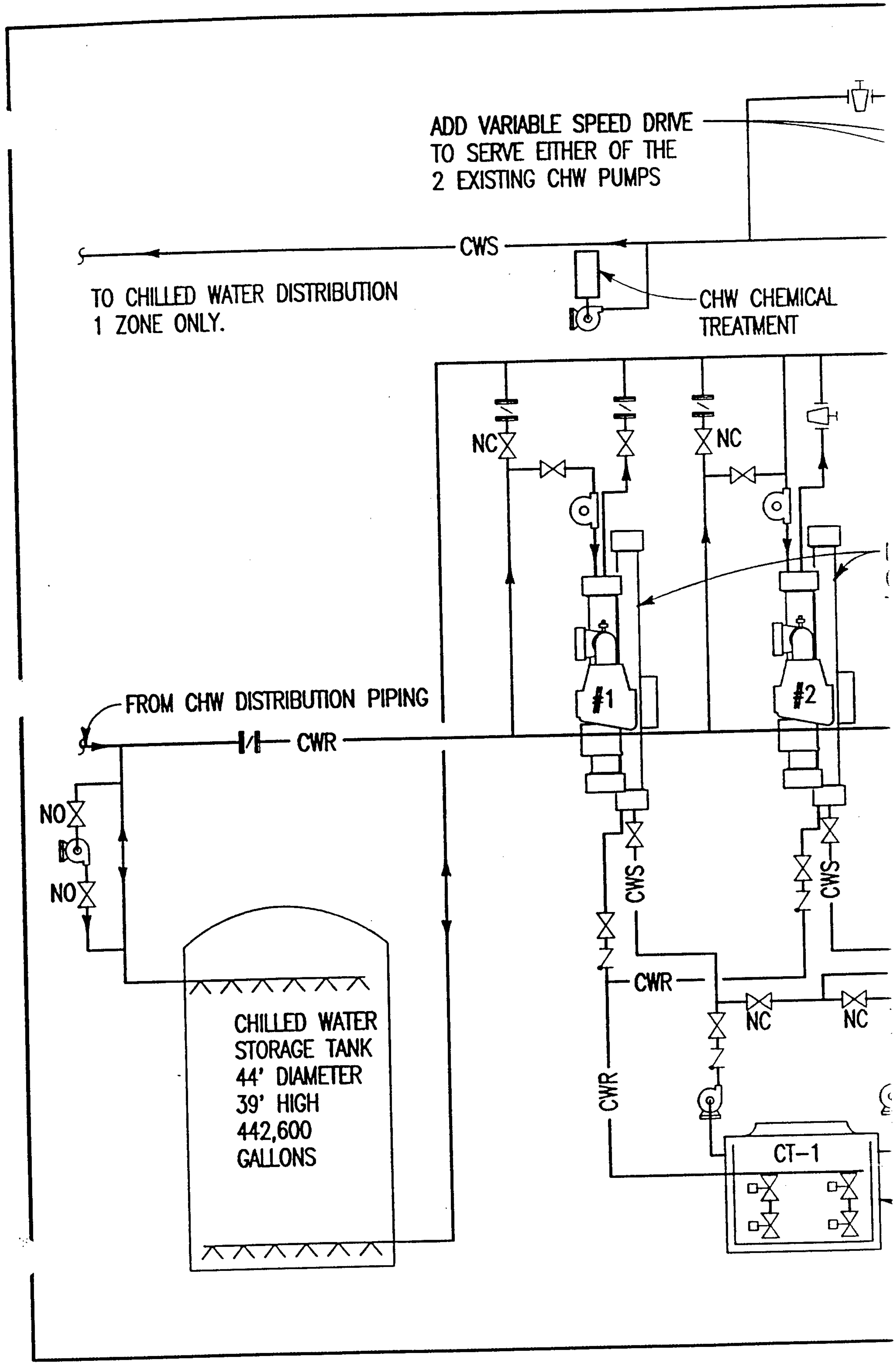
***Existing conditions within the physical plant is considered hazardous to unauthorized personnel. Signs and warnings are posted to alert unauthorized personnel access is restricted to authorized personnel and visitors with prior approval.

20C !HANDICAP PROVISIONS

***In accordance with Public Law 90-480, no provisions for the handicapped will be made in the project since the facility is used and operated solely by able bodied personnel. However, the main floor of the facility is at ground level and is handicap accessible.
/*

22B !PHYSICAL SECURITY

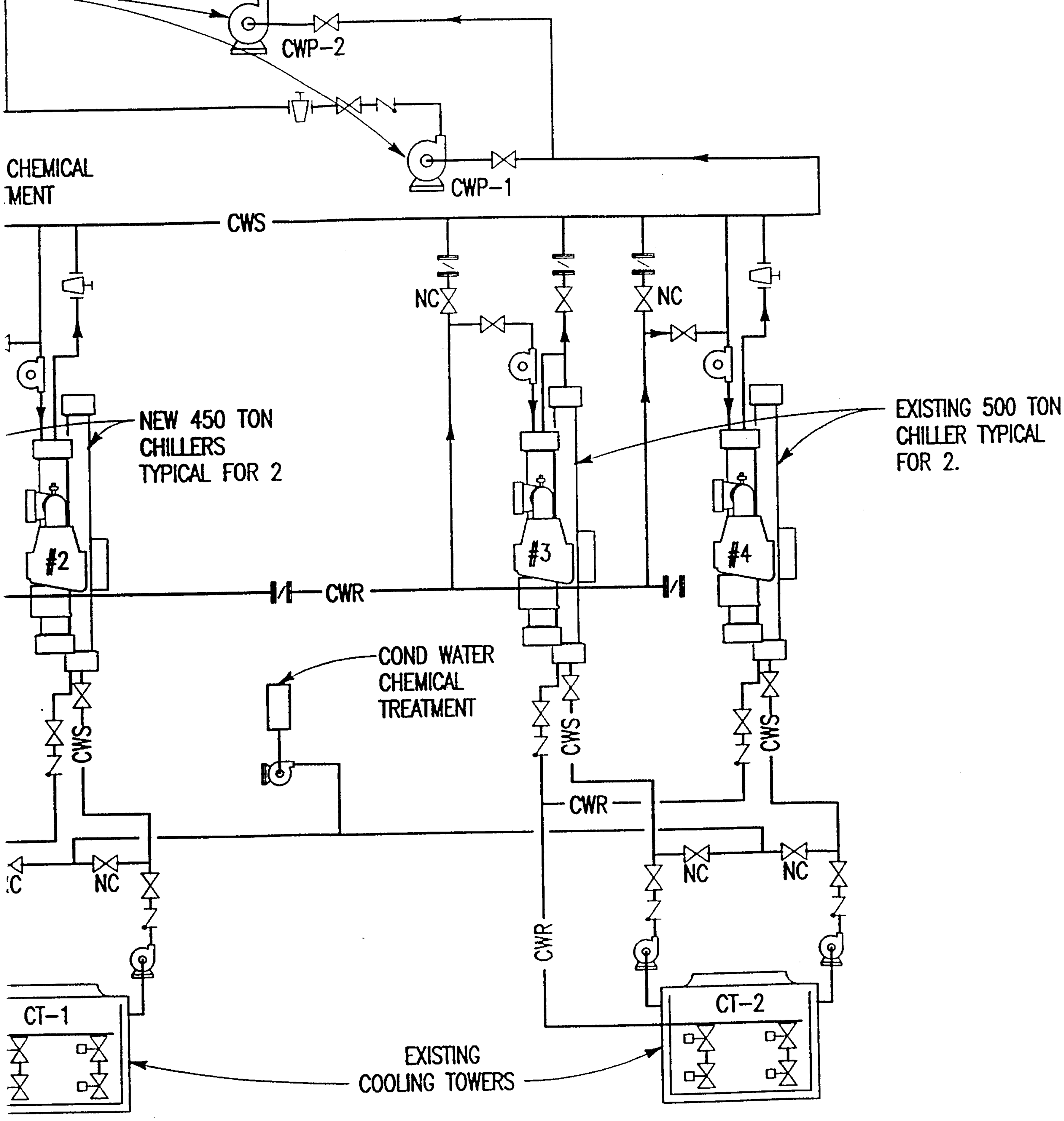
***Project is not considered for commercial activity. The physical plant upgrade to the existing Central Utility Plant will serve the north side of Ft. Gordon. Provisions of DA circular 235-1 are not applicable to this project.
/*



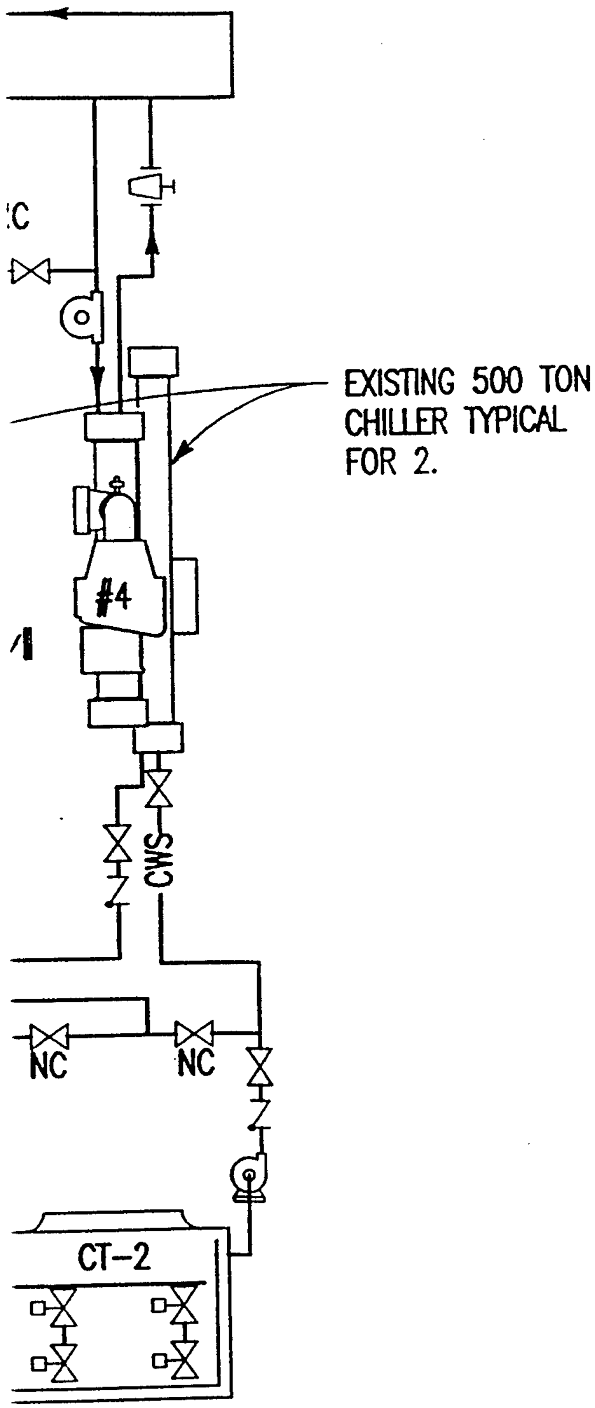
ADD VARIABLE SPEED DRIVE TO SERVE EITHER OF THE 2 EXISTING CHW PUMPS
CWS
TO CHILLED WATER DISTRIBUTION 1 ZONE ONLY.
CHW CHEMICAL TREATMENT
NC
NC
#1
#2
FROM CHW DISTRIBUTION PIPING
CWR
NO
NO
CWS
CWS
CWR
NC
NC
CWR
CHILLED WATER STORAGE TANK 44' DIAMETER 39' HIGH 442,600 GALLONS
CT-1

1

Project No. 2-Chilled Water Schematic Sout



] Water Schematic South-Bldg. 25330



3

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: LCC007

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3

PROJECT NO. & TITLE: 2 CHILLED WATER SOUTH

FISCAL YEAR 1994 DISCRETE PORTION NAME: CHW CHEMICAL TREATMENT

ANALYSIS DATE: 09-19-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 13910.		
B. SIOH	$ 765.		
C. DESIGN COST	$ 835.		
D. TOTAL COST (1A+1B+1C)	$ 15510.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 15510.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5994.	$ 0.		$ 0.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ -4000.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ -58960.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. CHW PIPING 16 YRS	$6000000.	16	.61	3660000.
2. CHW PIPING 20 YRS	$ -6,000,000	20	.54	-3240000.
d. TOTAL	$ 0.			420000.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4)$ 361040

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd4/(YRS ECONOMIC LIFE))$ 17000 .

5. SIMPLE PAYBACK PERIOD (1G/4) 1.10 YE

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 361040

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 23.28

(IF < 1 PROJECT DOES NOT QUALIFY)

** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR) N/A

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO020
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 2 CHILLED WATER SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: REPLACE CHILLERS
ANALYSIS DATE: 09-19-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 370062.		
B. SIOH	$ 20354.		
C. DESIGN COST	$ 22204.		
D. TOTAL COST (1A+1B+1C)	$ 412620.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 412620.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	10084.	$ 153632.	15.61	$ 2398200.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		4090.	$ 153632.		$ 2398200.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 2000.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 29480.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 29480.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 155632.

5. SIMPLE PAYBACK PERIOD (1G/4) 2.65 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 2427680.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 5.88
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 12.65 %

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: ECO024
LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 2 CHILLED WATER SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: VARIABLE SPEED PUMPING
ANALYSIS DATE: 09-26-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 285314.		
B. SIOH	$ 15693.		
C. DESIGN COST	$ 17119.		
D. TOTAL COST (1A+1B+1C)	$ 318126.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 318126.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	3310.	$ 50436.	15.61	$ 787309.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-2684.	$ 50436.		$ 787309.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 0.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 50436.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.31 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 787309.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.47
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.88 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO030
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 2 CHILLED WATER SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: CONTROLS
ANALYSIS DATE: 09-19-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 13986.		
B. SIOH	$ 770.		
C. DESIGN COST	$ 840.		
D. TOTAL COST (1A+1B+1C)	$ 15596.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 15596.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	157.	$ 2393.	15.61	$ 37351.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5837.	$ 2393.		$ 37351.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 2393.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.52 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 37351.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.39
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.70 %

LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: ECO044
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 2 CHILLED WATER SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: PIPING
ANALYSIS DATE: 01-13-95 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 30618.		
B. SIOH	$ 1684.		
C. DESIGN COST	$ 1837.		
D. TOTAL COST (1A+1B+1C)	$ 34139.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 34139.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	33.	$ 501.	15.61	$ 7825.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5961.	$ 501.		$ 7825.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 2000.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 29480.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. CHILLER 19 YRS	$ 450000.	19	.56	252000.
2. CHILLER 20 YRS	$-450000.	20	.54	-243000.
3. COOL TWRS 19 YRS	$ 86400.	19	.56	48384.
4. COOL TWRS 20 YRS	$ -86400.	20	.54	-46656.
d. TOTAL	$ 0.			10728.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 40208.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd4/(YRS ECONOMIC LIFE)) $ 3037.

5. SIMPLE PAYBACK PERIOD (1G/4) 11.24 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 48033.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.41
(IF < 1 PROJECT DOES NOT QUALIFY)

**** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO048
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 2 CHILLED WATER SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: WATER TREATMENT
ANALYSIS DATE: 01-13-95 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT
A. CONSTRUCTION COST $ 1765.
B. SIOH $ 97.
C. DESIGN COST $ 106.
D. TOTAL COST (1A+1B+1C) $ 1968.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 1968.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	131.	$ 1994.	15.61	$ 31125.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5863.	$ 1994.		$ 31125.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 2000.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 29480.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. COOL TWRS 18 YRS	$ 86400.	18	.58	50112.
2. COOL TWRS 20 YRS	$ -86400.	20	.54	-46656.
d. TOTAL	$ 0.			3456.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 32936.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd4/(YRS ECONOMIC LIFE))$ 4167.

5. SIMPLE PAYBACK PERIOD (1G/4) .47 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 64061.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 32.55
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 22.71 %

LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: ECO054
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 2 CHILLED WATER SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: CHW STORAGE
ANALYSIS DATE: 09-19-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 252126.	
B. SIOH	$ 13867.	
C. DESIGN COST	$ 15128.	
D. TOTAL COST (1A+1B+1C)	$ 281121.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 281121.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 75868.	14.74	$ 1118298.
N. TOTAL		-5994.	$ 75868.		$ 1118298.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) — $ 0.
(1) DISCOUNT FACTOR (TABLE A) — 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) — $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 75868.

5. SIMPLE PAYBACK PERIOD (1G/4) 3.71 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 1118298.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 3.98
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 10.47 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO087
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 2 CHILLED WATER SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: CONTROLS
ANALYSIS DATE: 09-19-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 43871.		
B. SIOH	$ 2413.		
C. DESIGN COST	$ 2633.		
D. TOTAL COST (1A+1B+1C)	$ 48917.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 48917.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	339.	$ 5158.	15.61	$ 80516.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5655.	$ 5158.		$ 80516.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 0.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 5158.

5. SIMPLE PAYBACK PERIOD (1G/4) 9.48 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 80516.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.65
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 5.70 %

PROJECT NO. 3

HIGH TEMPERATURE WATER NORTH

BUILDING 25910

GENERAL PROJECT NO. 3

GENERAL DESCRIPTION:

The concept of the heating plant as a steam generating boiler plant which sparges steam into the high temperature water, which is then pumped through the underground pipe distribution, has changed completely. The new concept is to replace the steam boilers with hot water generators which operate in a primary loop circulating HTW from and to the three existing cascade heaters which will be converted for use as expansion/storage tanks. Variable speed pumps draw water from the expansion/storage tank discharge and pump HTW to the buildings on the distribution system which already have 2 way valves. The expansion/storage tanks will now be pressurized with nitrogen and the pressure on the tank will vary as the water level increases or decreases. The water level will change based on the variable speed pumping changes and water losses in the system. The existing deaerator needs to be modified before any other work is done. The deaerator vessel and storage tank are hopefully reusable, but it is our suspicion that the trays within the deaerator are not operating and need to be replaced entirely. Another item that needs to be done prior to making the switch over from steam to hot water is to add chemical feed tanks and have chemicals fed at the appropriate locations. This should be done in coordination with the chemical supplier, but basically we are adding sulfite and ph control to the make-up water in the deaerator or immediately after the deaerator. Then there is an additional chemical that needs to be added to the distribution system to make sure that the oxygen corrosion is not a problem, and that exposed piping does not corrode. The distribution piping shall also be protected from oxygen pitting and ph imbalance when the make-up water requirement is reduced and the dearator is made to more effectively dearate with less chemicals being added.

Because there is a multiplicity of units available to be converted and to be replaced with new, it is possible that the steam can remain in operation while the new hot water generators are added and one or more of the cascade heaters is converted so that the Plant can serve the needs of the distribution system during the construction period. Then there will be a small shutdown period where steam generation will be converted over to hot water generation. If this can be coordinated with the summer shutdown so that all of the work in the buildings is completed to locally generate domestic water, then the HTW system can be shutdown 4-1/2 months of the summer to make this conversion from steam to hot water generation.

COMPILATION OF DATA:

From the ECO data compilation you will see the total of seven ECO's total a cost of more than $2,336,238. The simple payback is 6.58 years and the SIR is 2.83 for the total Project No. 3. The LCCD sheet for Project No. 3 shows the same results.

CONCLUSION:

Data for this analysis was based on an assumed existing efficiency of the boilers of 70%. This assumption was made without any accurate information on the efficiencies of the boilers. Recent articles in the ASHRAE Journal and elsewhere indicates that for the Plant as it is now, 70% is probably a very high efficiency for the actual conditions. Even with the payback indicated, we can expect a better payback if the project is well designed and operators develop a concern for energy savings. There are also opportunities to increase the savings if higher efficiency equipment is installed in the buildings on the distribution system. We assumed 80% efficiency for gas combustion, but there are gas-fired heaters that can get into the 90% range. This costs additional money, but may be worthwhile on the basis of dollars saved when the natural gas prices at the time of project completion are compared with high efficiency water heating equipment prices at the same time.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: PROJ003
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 3 HTW NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: COMPOSITE
ANALYSIS DATE: 02-19-95 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 2095527.		
B. SIOH	$ 115254.		
C. DESIGN COST	$ 125732.		
D. TOTAL COST (1A+1B+1C)	$ 2336513.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 2336513.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	1780.	$ 27125.	15.61	$ 423426.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	45645.	$ 205402.	20.96	$ 4305225.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		41431.	$ 232527.		$ 4728651.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 110659.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 1631114.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. TOTAL	$ 241500.	0	1.00	241500.
d. TOTAL	$ 241500.			241500.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 1872614.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 355261.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.58 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 6601264.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.83
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 8.60 %

PROJECT NO. 3 - HIGH TEMPERATURE WATER NORTH

ECO DATA COMPILATION

ECO NO.	DESCRIPTION	CONSTRUCTION COST	ANNUAL RECURRING COST	NON-RECURRING COST (-) SAVINGS (+)	COST (From LCC)	ELECTRICAL SAVINGS MMBTU/YR	NAT GAS SAVINGS MMBTU/YR	SAVINGS 1stYEAR	TOTAL DISCOUNT SAVINGS
25	Variable Speed Hot Water Pumping	161,421.12	4,000	0	179,986	785.13	0	15,962	245,689
27	Return Hot Water Temperature Control	63,315.00	10,000	0	70,597	0	2,040.20	19,181	339,832
31	Reduce Make-Up Water-Hot Water	55,112.40	1,684	0	61,451	0	5,587.70	26,829	551,858
67	Hot Water Generators	1,344,905.10	15,000	5 Items from LCCD on ECO 67	1,499,570	0	15,736.03	97,887	1,946,822
69C	Summer Shut Down (1/2 Gas, 1/2 Heat Pumps)	402,417.70	79,795	0	448,696	995.23	17,161.56	172,367	3,034,235
71	Reduce Steam Leaks	1,842.75	0	0	2,056	0	398.58	1,793	37,594
88	EMCS Controls & Instrumentation	66,512.88	0	0	74,163	0	4,720.81	21,244	445,267
	Totals	2,095,527	110,659	Same as ECO 67	2,336,519	1780.36	45,644.88	355,263	6,601,297

Simple Payback: $\frac{2,336,519}{355,263} = 6.58$ years

SIR: $\frac{6,601,297}{2,336,519} = 2.83$

ECO METHODOLOGY FORM

ECO NAME:	Variable Speed HTW Pumping
ECO NUMBER:	25
TYPE: BLDG SYSTEM:	Bldg. 25910 Heating

EXISTING CONDITIONS:

There are three zones leaving Plant 25910. Each has a set of identical pumps serving each zone. Zones 1 and 3 have 50 hp motors rated at 3550 gpm. Zone 2 has the same pump with a 75 hp motor rated at 3550 gpm. The pumps usually operate on the low speed which is 1750 gpm, and the horsepower is 1/4 of that given above at the higher speeds. Pumps in Zone 1 are Dean Brothers pumps sizes 3 x 4 x 9-1/4 impeller, Model No. 8434; the Serial No. on one of the pumps is 148840. The pumps in the other zones are similar. Just upstream of the HTW pumps is the blending station which blends return HTW with water leaving the cascade heater to maintain a setpoint temperature at the blending station for HTW supply water. Water levels in the cascade heaters are effected by the setpoints on the HTW blending stations. By decreasing the temperature setting on Zone 3 Blending Station, it was noted that the HTW return water flow increased and then the level of the cascade heater above Zone 3 went up relative to the water levels in the other cascade heaters. Entering each building at the distribution system is a 2-way valve so that when HTW is not required in the building on the distribution system, the flow ceases to that building.

PROPOSED CHANGE:

To reduce the energy use for pumping to three separate zones, it makes sense to not only combine pumping to one set of two pumps with one pump to backup the other, but to make the pumps variable speed drive so that energy savings can be obtained. Repiping from the cascade heaters into the single pumping station will be required as a part of this Project No. 3. Blending stations will be eliminated. Pump selection shall be 800 gpm at 85 ft. of head and 1750 rpm using a 25 horsepower motor. One variable speed drive will be equipped to operate either 3500 rpm pump motor and will be able to go up to higher head pressures with higher rpms than the 1750 rpm nominal speed. The basis of this selection is the fact that the existing motors and pumps in the three Zones have always run at the low speed and accommodated the heating requirements of the distribution system. Controls will vary the pump speed to maintain a fixed pressure differential between the HTW supply and the HTW return water.

CALCULATION & COST METHODOLOGY:

The savings will be based entirely on the difference between the constant speed of the three motors and one single variable speed drive with the new pump set. Existing motors are two speed and are rated at 50 HP for two sets of pumps and 75 HP for one set of pumps at 3550 rpm. Since one pump is always running on each zone and usually at low speed, the normal power usage is the average for 1750 rpm as follows:

50 hp at 1750 rpm = 12.5 hp
75 hp at 1750 rpm = 19 hp

Hp consumed is (2 x 12.5) + (1 x 19) = 44 hp/hr year round

At 800 watts/hp x 44 hp/yr ÷ $\frac{\text{1000 watts}}{\text{KW}}$ = 35.2 KW/hr

8760 hrs/yr. x 35.2 KW/hr = 308,352 KW/yr.

From the B&G Pumping System Analysis on the following page, we see that the new 25 hp pump operating with a variable speed drive will use only 78,310.06 KWH/yr.
The savings is therefore 308,352 - 78,310.06 = 230,041.94 KWH/yr.
In Million Btu's: 230,041.94 x $\frac{3413}{10^6}$ = 785.13 Million Btu's/yr.

ECO METHODOLOGY FORM

ECO NAME:	Variable Speed HTW Pumping (Cont'd)
ECO NUMBER:	25
TYPE: BLDG SYSTEM:	Bldg. 25910 Heating
CALCULATION & COST METHODOLOGY:	

By eliminating the Blending Stations and two sets of pumps, the maintenance cost can be reduced by 4,000/yr. The cost will be based on the following information:

Electrical work			
Materials	$ 4,000	Labor	$ 6,000
Piping modifications			
Materials	$20,000	Labor	$25,000
Demolition			
		Labor	$15,000
New pumps with motors (2)			
Material	$25,000	Labor	$ 3,000
Variable speed drive (1)			
Materials	$ 8,500	Labor	$ 1,000
Switches for motor			
Materials	$4,340	Labor	$ 1,000

B&G Pumping System Analysis: BLDG 25910 HEATING

SUMMARY OF INPUT DATA: Office, heating

System peak demand:	800.00 gpm	
System discharge pressure:	85.00 ft.	(36.82 psig)
Minimum control/Static pressure:	20.00 ft.	(8.66 psig)

Standard Efficiency (SE) 60-cycle motor.

1 Pump System:

Pump 1: Series 1510 5E, Impeller diameter 9.875"
Design RPM = 1750.0, Motor HP = 25.00

CONSTANT SPEED OPERATION:

Hrs	Q/Qd,%	TGPM	TDH,ft	BHP	Ep,%	BHP/HP,m	HP,in	E,mtr,%	kWHR	$/day	E,w/w,%
2.40	20.0	160.0	95.1	16.37	23.5	0.655	18.77	87.2	33.6	1.34	20.5
2.40	40.0	320.0	95.1	16.37	46.9	0.655	18.77	87.2	33.6	1.34	40.9
3.60	50.0	400.0	95.1	16.37	58.7	0.655	18.77	87.2	50.4	2.02	51.1
4.80	60.0	480.0	94.8	16.37	70.2	0.655	18.77	87.2	67.2	2.69	61.2
4.80	70.0	560.0	93.8	17.47	75.9	0.699	20.00	87.3	71.6	2.86	66.3
2.40	80.0	640.0	92.1	18.75	79.3	0.750	21.42	87.5	38.3	1.53	69.5
2.40	90.0	720.0	89.6	19.84	82.1	0.794	22.63	87.7	40.5	1.62	71.9
1.20	100.0	800.0	86.6	20.86	83.9	0.834	23.81	87.6	21.3	0.85	73.5

COST SUMMARY:

Annual Operating Cost @ $0.04 / kwhr = $ 5205.02
8760 hours/year or 100.00%
Total annual operating cost = $ 5205.02
Total kW hours = 130125.59

VARIABLE SPEED OPERATION: (Table 1 of 1)

System suction pressure: 0.00 ft. (0.00 psig)
Best Efficiency Staging is ON

Hrs	Q/Qd,%	TGPM	TDH,ft	BHP	Ep,%	RPM	HP,in	E,d/m,%	kWHR	$/day	E,w/w,%
2.40	20.0	160.0	22.6	2.65	34.5	855.7	3.81	69.4	6.8	0.27	24.0
2.40	40.0	320.0	30.4	7.12	34.5	995.0	9.42	75.6	16.9	0.67	26.1
3.60	50.0	400.0	36.3	10.61	34.5	1097.6	13.44	79.0	36.1	1.44	27.3
4.80	60.0	480.0	43.4	7.41	71.0	1207.5	9.13	81.2	32.7	1.31	57.6
4.80	70.0	560.0	51.8	9.68	75.7	1339.5	11.55	83.8	41.4	1.65	63.5
2.40	80.0	640.0	61.6	12.55	79.3	1464.1	14.69	85.4	26.3	1.05	67.8
2.40	90.0	720.0	72.7	16.12	82.0	1603.4	18.67	86.3	33.4	1.34	70.8
1.20	100.0	800.0	85.0	20.51	83.7	1735.3	23.52	87.2	21.0	0.84	73.0

Annual Operating Cost @ $0.04 / kwhr = $ 3132.40
8760 hours/year or 100.00%
Total kW hours = 78310.06

COST SUMMARY:

Suction Pressure   : 0.0 psig
Percent of Year   : 100%
Hours/Year   : 8760
Annual Operating Cost: $3132.40

Total hours/year   = 8760
Total annual operating cost = $3132.40

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CONSTRUCTION COST ESTIMATE | **DATE:** 23 SEPT 94 | **SHEET 1 OF 1**

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA | **PROJ. NO.** 3

Arch/Engr: HARRISON AND SPENCER, INC. | **CODE:** BLDG 25910

Summary: ECO #25 - VARIABLE HTW PUMPING | **Estimator:** H. TOUB | **Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
ELECTRICAL WORK	1	LS	4000	4000	6000	6000	$10,000.00
PIPING	1	LS	20000	20000	25000	25000	$45,000.00
DEMOLITION	1	LS			15000	15000	$15,000.00
NEW PUMPS	2	EA	12500	25000	3000	6000	$31,000.00
VARIABLE SPEED DRIVE	1	LS	8500	8500	1000	1000	$9,500.00
SWITCHES	1	LS	4340	4340	1000	1000	$5,340.00
	SUBTOTAL			61840		54000	
	5% SALES TAX			$3,092.00			
	17% LABOR TAX					$9,180.00	
	SUBTOTALS			$64,932.00		$63,180.00	$128,112.00
	20% OH (GC ONLY)						$25,622.40
	SUBTOTAL GC'S WORK						$153,734.40
	SUBTOTAL(GC & SUBS)						$153,734.40
	10% GC'S PROFIT						
	5% CONTINGENCY						$7,686.72
	TOTAL						**$161,421.12**

ECO METHODOLOGY FORM

ECO NAME:	Controls For Return HTW Temperature Regulation
ECO NUMBER:	27
TYPE: BLDG SYSTEM:	Bldg. 25910 Heating

EXISTING CONDITIONS:

HTW is heated in cascade heaters, which is usually maintained at the temperature of the saturation pressure of the boiler, and this boiler pressure is usually maintained except for several times a year when it is changed. At 150 psi, the saturation temperature is 347°F. When the HTW water leaves the cascade heaters, it passes through a blender that adds unheated HTW return to control the setpoint that maintains the constant HTW supply temperature. Note that as distribution loads vary; less or more HTW water is required, and the HTW return temperature rises and falls depending upon the load. The existing system operates to control the HTW supply water, and does not take into account changes to load that would effect the overall heating requirements.

PROPOSED CHANGE:

Because the existing boilers are now going to be replaced with hot water generators, the controls in the Control Room will basically have to be changed. The controls will now regulate the high temperature water supply temperature, which will be based on firing the hot water generators to maintain the temperature in the storage tanks. This water will be circulated through the distribution system, and the firing rate of the hot water generators will be maintained based on a setpoint for the high temperature water supply. The HTW supply temperature setpoint will be varied by the EMCS to maintain the lowest acceptable HTW return temperature to adequately serve all buildings on the distribution system. These controls will also be monitored and, in some cases, controlled by the EMCS system so that temperatures in various buildings will establish energy efficient setpoint temperatures for high temperature water supply in a very short time by this monitoring at the EMCS. Therefore, this ECO, including the cost of new Control Room controls and the tie-ins to the EMCS, will be in the Control Room only. ECO 88 includes new EMCS controls that will cover the cost of any wiring from the Control Room to the EMCS system. The HTW return water temperature will also be monitored at the EMCS. The EMCS personnel will provide an HTW supply setpoint temperature based on their experience and time of day usage of high temperature water throughout the distribution system.

CALCULATION & COST METHODOLOGY

Line losses in the HTW distribution piping will be decreased as a percentage of the temperature difference between the trench temperature and the HTW in the piping. If it is assumed that the difference in ground temperature to the pipe temperature is the difference between 325°F and 70°F; the average is now 255°F. After reducing the supply temperature to 300°F, this will reduce the difference to 230°F. This decreases the line loss by .1087. Since the minimum summer month hourly Btu usage is approximately 2,000,000 Btu's, it is reasonably assumed that the line loss is 1,500,000 Btu's per hour. The savings is therefore .1087 x 1.5 million divided by the boiler efficiency of .7 and also divided by 100,000 Btu's per therm. This comes to a savings of 2.329 therms per hour or 0.2329 million Btu/hr. This savings is maintained year round for 8,760 hours per year which totals 2040.204 million Btu's/yr.

The cost of new controls in the Control Room will be mostly for firing and temperature controls to determine hot water temperatures pressures and flows at the following locations as a minimum.

HTW Return Pipes (3)	(flow, temp, pressure)
HTW Supply Pipes (3)	(flow, temp, pressure)
Expansion Tanks (3)	(temp, pressure)
Deaerator Tank	(temp)
Hot Water Leaving Generators (3)	(temp)
Hot Water Entering Generators (3)	(temp)

ECO METHODOLOGY FORM

ECO NAME:	Controls For Return HTW Temperature Regulation (Cont'd)
ECO NUMBER:	27
TYPE: BLDG	Bldg. 25910
SYSTEM:	Heating

CALCULATION & COST METHODOLOGY:

A Btu meter will total fuel input based on values totaled at the above instrumentation. Remote firing controls will be located in the Control Room also. The many hours that are spent on maintaining the existing boiler controls will be reduced with the new simplified controls. The annual manpower savings will be $10,000/yr.

CONSTRUCTION COST ESTIMATE	DATE: 23 SEPT 94	SHEET 1 OF 1

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA — **PROJ. NO.** 3

Arch/Engr: HARRISON AND SPENCER, INC. — **CODE:** BLDG 25910

Summary: ECO #27 - TEMPERATURE CONTROLS — **Estimator:** H. TOUB — **Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	QUANTITY UNIT	MATERIAL UNIT COST	MATERIAL EXTENSION	LABOR UNIT COST	LABOR EXTENSION	TOTAL
CONTROLS	1	LS	20000	20000	15000	15000	$35,000.00
DEMOLITION OF CONTROL EQUIPMENT	1	LS				10000	$10,000.00
	SUBTOTAL			20000		25000	
	5% SALES TAX			$1,000.00			
	17% LABOR TAX					$4,250.00	
	SUBTOTALS			$21,000.00		$29,250.00	$50,250.00
	20% OH (GC ONLY)						$10,050.00
	SUBTOTAL GC'S WORK						$60,300.00
	SUBTOTAL(GC & SUBS)						$60,300.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$3,015.00
	TOTAL						**$63,315.00**

ECO METHODOLOGY FORM

ECO NAME: Reduce Make-Up Water in HTW System

ECO NUMBER: 31

TYPE: BLDG Bldg. 25910
SYSTEM: Heating

EXISTING CONDITIONS: The total number of gallons lost in Building 25910 over the course of 1992 is 2,039,102 gallons. This leakage is caused by pipe failures and operating inefficiencies in the system. The quantity of lost water is based on reports of water meter readings made by the boiler plant operators.

PROPOSED CHANGE: It is proposed that flow meters and temperature gauges be installed at various locations throughout the north HTW distribution piping so that actual flows can be measured to determine where water is not being returned from where it is supplied. New flow meters and temperature gauges will be included in the cost of this ECO, and the wiring from them to the EMCS system will be included in ECO 88 in this Project No. 3.

CALCULATION & COST METHODOLOGY: The cost is based on locating flow meter and temperature RTD's in various distribution locations throughout the HTW distribution piping. Once they are located in this ECO, ECO 88 for EMCS wiring will absorb the cost to wire them to the nearest building and then go back to the EMCS system. The savings is the heat loss of the water lost from the HTW system, that can be determined and is based on

2,039,102 gallons x 8.34 lb/gal x (300°-70°Δt) = 3.9114 x 10^9 Btu/yr = 3,911.4 million Btu's/yr or 39,114 therms Gas to make up loss of heat

$\frac{39{,}114}{.7}$ Boiler Eff. = 55,877 therms @ \$.45/therm = \$25,145/yr.

The gas savings is 5587.7 million Btu's/yr.

2,039,102 gal x \$.826/1000 gal = \$1684.30/yr is the annual recurring cost for purchasing the lost water.

The cost of repairing any water leaks in an ongoing maintenance item that is presently handled with work orders and is not funded in this Project/ECO.

CONSTRUCTION COST ESTIMATE				DATE: 23 SEPT 94		SHEET 1 OF 1	
Project: FORT GORDON ENERGY STUDY							
Location: AUGUSTA, GEORGIA					PROJ. NO. 3		
Arch/Engr: HARRISON AND SPENCER, INC.					CODE: BLDG 25910		
Summary: ECO #31 REDUCE HTW MAKE-UP WATER		Estimator: H. TOUB			Checked:		

ITEM DESCRIPTION	QUANTITY QUAN	QUANTITY UNIT	MATERIAL UNIT COST	MATERIAL EXTENSION	LABOR UNIT COST	LABOR EXTENSION	TOTAL
FLOW METERS	12	EA	1500	18000	10000	12000	$30,000.00
TEMP RTD IN DISTRIBUTION PIPE	12	EA	300	3600	500	6000	$9,600.00
	SUBTOTAL			21600		18000	
	5% SALES TAX			$1,080.00			
	17% LABOR TAX					$3,060.00	
	SUBTOTALS			$22,680.00		$21,060.00	$43,740.00
	20% OH (GC ONLY)						$8,748.00
	SUBTOTAL GC'S WORK						$52,488.00
	SUBTOTAL(GC & SUBS)						$52,488.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$2,624.40
	TOTAL						**$55,112.40**

ECO METHODOLOGY FORM

ECO NAME:	Replace Existing Boiler with Hot Water Generators
ECO NUMBER:	67
TYPE: BLDG SYSTEM:	Bldg. 25910 Heating

EXISTING CONDITIONS:

There are five boilers in Building 25910 heating and cooling plant which have not been tested for combustion efficiency in the studies conducted several years ago because of reported asbestos. These boilers are firing with natural gas and No. 2 oil, but they were originally built for coal firing. 70% combustion efficiency is assumed for this report, but it would not be surprising if , upon conducting tests, this efficiency was found to be lower than 70%. The furnace area is spacious with less heat absorbing tubes than would be in a boiler designed for natural gas firing. The rear section of the boiler is under negative pressure from the high stack and ID fans allow air leakage into the boiler. From the recorded temperatures leaving the boilers it is reasonable to believe that air leakage is reducing the expected flue gas temperature by 70-100°F. Only three of the five boilers are currently operable in 1994.

PROPOSED CHANGE:

The following change items should occur roughly in the order in which they are listed. The first thing that needs to be done will be the replacement of the existing deaerator internals so that the deaerator performs its intended function, which it is not doing now nor has it been doing in the past seven to eight years that we know about. Secondly, chemical feed tanks shall be added to add ph and sulfites to the deaerator and its storage tank. A chemical feed tank shall be added as an oxygen absorber for pipe protection to the circulating water system at the HTW return water piping. Thirdly, a nitrogen storage system with piping to the cascade heaters that will be converted to expansion/ storage tanks should be put in place. Fourthly, an effort should be made to make the cascade heaters into thermal expansion tanks/storage tanks. These tanks will be used for a circulating hot water system vs. their current use as a cascade heater which mixes steam with HTW water. These four revisions shall take place so that the steam boiler system can maintain its operation while the changes are being made to prepare for the new hot water generators to start their function. Fifthly, existing steam boilers that are not in use shall be demolished and removed from the building. As the system is converted from steam to high temperature water systems, the remaining boilers shall be demolished. Sixthly, three HTW zones shall be repiped so that one zone will be all that is required, and that one zone will come out of the one pump which will be driven with a variable speed drive. The pump is part of this project, but is listed in another ECO 25. The common piping for the supply and return is part of this ECO. Seventh is the installation of three new hot water generators. They will be sized for 35,000,000 Btu's per hour each output. Two of them will be required to handle the full load and the third one will be a back-up. The generator price includes controls and an economizer on the stack which will be part of the generator purchase. The unit will not have any ID fans, and the breeching and flue that is existing from the outlet of the boilers to the stack, and including the stack, will be abandoned in place.

CALCULATION & COST METHODOLOGY:

The Proposed Change will result in savings due to the increased efficiency of hot water generator combustion over that of the existing steam boilers. It will result in a deaerator operating properly so that the new equipment's life is considerably longer than the life of the steam boilers now and the very short life of the existing economizer in the stack. Simplicity of the system will also reduce the hours required to maintain the existing controls and the boiler firing equipment by 600 man hours or $15,000 per year. For non-recurring costs, compare the existing non-deaerated boiler with five boilers with a 10-year life (when treated) and an economizer with a 2-year life with three hot water generators with a 20-year life when treated as defined in this ECO. Also, the plant piping will last only fifteen years with existing treatment, and will last 20 years with the new treatment recommended.

ECO METHODOLOGY FORM

ECO NAME:	Replace Existing Boiler with Hot Water Generators (Cont'd)
ECO NUMBER:	67
TYPE: BLDG SYSTEM:	Bldg. 25910 Heating
CALCULATION & COST METHODOLOGY:	

Savings are shown as 10% based on 70% efficiency for existing boilers and 80% efficiency for the new hot water generators.

$$.10 \times \frac{152{,}777 \text{ MCF} \times 1{,}030{,}000 \text{ Btu/MCF}}{100{,}000 \text{ Btu/therms}} = 157{,}360 \text{ therms} = 15{,}736.03 \text{ Million Btu/yr.}$$

At $.45/therm = $70,812/yr savings

Maintenance manhours saved at Plant
600 manhours @ $25 = $15,000/yr

Cost:

Hot water generator 3 @ $250,000			
Materials	$750,000	Labor	$100,000
Repiping of Cascade Heaters (3) Tanks			
Materials	$ 9,000	Labor	$ 12,000
Repiping to combine three zones into one for hot water			
Materials	$ 20,000	Labor	$ 30,000
Demolition:		Labor	$ 35,000
Deaerator repair			
Materials	$ 5,000	Labor	$ 7,500
Chemical feed tanks (3)			
Materials	$ 7,500	Labor	$ 1,500
Nitrogen storage and piping			
Materials	$ 10,000	Labor	$ 7,000

CONSTRUCTION COST ESTIMATE	DATE: 23 SEP 94	SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY		
Location: AUGUSTA, GEORGIA	PROJ. NO. 3	
Arch/Engr: HARRISON AND SPENCER, INC.	CODE: BLDG 25910	
Summary: ECO #67 - H.W. GENERATOR SYS	Estimator: H. TOUB	Checked:

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
HOT WATER GENERATOR	3	EA	250000	750000	LUMP SUM	100000	$850,000.00
REPIPING OF CASCADE HEATER	3	TON	3000	9000	4000	12000	$21,000.00
PIPING FOR 1 ZONE FROM 3 ZONES	1	LS	20000	20000	30000	30000	$50,000.00
DEMOLITION	1	LS			35000	35000	$35,000.00
DEARATOR REPAIR	1	LS	5000	5000	7500	7500	$12,500.00
CHEMICAL FEED EQUIPMENT	3	EA	2500	7500	500	1500	$9,000.00
NITROGEN STORAGE & PIPING	1	LS	10000	10000	7000	7000	$17,000.00
	SUBTOTALS 1			$801,500.00		$193,000.00	$994,500.00
	5% SALES TAX			$40,075.00			$40,075.00
	17% LABOR TAX					$32,810.00	$32,810.00
	SUBTOTALS 2			$841,575.00		$225,810.00	$1,067,385.00
	20% GC OH & PROFIT						$213,477.00
SUB-CONTRACTORS	SUBTOTAL GC WORK						$1,280,862.00
	TOTAL SUB WORK						
	10% GC SUB PROFIT						
	5% CONTINGENCY ON JOB						$64,043.10
	TOTAL						$1,344,905.10

ECO METHODOLOGY FORM

ECO NAME: Summer Shutdown of HTW System

ECO NUMBER: 69

TYPE: BLDG North Distribution
SYSTEM: Heating

EXISTING CONDITIONS: Space heating is not required from mid-May through the end of September, but a boiler must be in operation to handle domestic water needs and cooking requirements in some cases with the HTW distribution system.

PROPOSED CHANGE: Provide onsite water heaters at each building for domestic water usage. Water heaters should be about 10% more efficient than the boiler plant, i.e., 80%. Use of water heaters should also eliminate the heat loss in the distribution line during this 4-1/2 month period. It will also eliminate supervision of the boilers for 4-1/2 months. The HTW system should either be left full of water or pressurized with nitrogen to avoid corrosion during the period of non-use. The buildings will have hot water generating equipment, which will be heat pumps or gas-fired equipment . The heat pump operates at a COP of 3±. Cool air generated by the heat pump can be used in the buildings to cool air spaces that would not now be cooled or that can be cooled depending on domestic water demand rather than space conditions, i.e., Laundry Room, Hallways, or unused Classroom areas. In some buildings, the cool air generated by the heat pumps controlled to make domestic hot water can be used to supplement the large air handling units so that less chilled water from the CHW distribution system will be required. When this is done, warm air must always be available for domestic water heating regardless of the demand for space cooling in the building. Gas-fired equipment will be more expeditious where there is no use for the chilled air in the building being converted. Each building type should be evaluated with a life cycle cost analysis to see if the higher initial cost of the heat pump and associated equipment results in enough extra energy savings to warrant the extra cost.

CALCULATION & COST METHODOLOGY: Methodology for computing the savings for the summer shutdown is based on taking the total amount of gas used during the summer months, May through September, and subtracting from that the estimated hot water consumption in all of the buildings on the distribution system, heat loss in the hot water storage tanks in all of the buildings. Since there is no space heating during these months, the difference between the domestic water heat use and the total HTW heating will be the amount of line loss in the distribution system for HTW. In addition to the savings of line loss of the HTW distribution system, the individual equipment that will be put in the distribution system buildings will have an 80% efficiency whether it is gas-fired equipment or heat pumps that we calculate to have an equal operating cost to gas-fired equipment. Therefore, the calculations become the same. Taking an 80% efficiency for gas-fired equipment and a 2.7 COP for heat pump operation, and using the cost available we calculate below to see that the same cost is derived for both systems per Btu. Because the cost of a Btu is the same, we can therefore easily calculate the savings with gas-fired equipment, and will assume the heating with a heat pump is going to cost the same. Therefore, it comes to the same value for the energy saved. The total savings of the higher efficiency equipment is then added to the line loss which will be saved by shutting down the Main Plant, which gives a total savings in gas over the 4-1/2 month period in which the Main Plaint will be shut down. In addition to the energy savings, the manpower at the Plant can be reduced by one man for 4-1/2 months at $25/hour. We have added back in some money for shutting down the Plant and isolating the piping which will not be used during the HTW shut down. Separately, heat pumps are compared with natural gas-fired water heaters for the summer heating in each of the buildings. The heat pumps are creating hot water, as well as cold air, so the cold air is free because the heating with the heat pumps is exactly equivalent to the heating with natural gas. Cost of gas heaters in each of the buildings is then worked up, and the cost of the heat pumps is worked up.

ECO METHODOLOGY FORM

ECO NAME:	Summer Shutdown of HTW System (Cont'd)
ECO NUMBER:	69
TYPE: BLDG SYSTEM:	North Distribution Heating

CALCULATION & COST METHODOLOGY:

Three life cycle cost analyses are shown with this ECO. ECO 69A is worked up for using heat pumps only in all the 96 buildings that need to be modified for summer usage. ECO 69B is worked up for gas used to generate hot water in all of the 96 buildings. ECO 69C is taking the cost of both of the two options and dividing it by two, thereby assuming half the buildings will require heat pumps and half the buildings will require gas. The savings for ECO 69C will be full savings of natural gas which will be shutting down the Plant, and half of the savings allocated to the free cooling will be derived by using heat pumps. Heat pumps vs. gas-fired equipment will be determined by looking at each individual building and determining if there is the possibility of using heat pumps to generate cooling so that they can decrease the cooling load and also take advantage of the fact that we got this cooling as a by-product by producing hot water in the summer time. The purpose of this calculation assumes that half of the buildings qualify for heat pumps and half of the buildings qualify for gas-fired equipment.

From weather data TM 5-785 it appears heat would not be needed for half of May and all of June, July, August, and September which is 4-1/2 months.

From 1992 Boiler Logs Heating Plant Gas Consumption for Months:

May	-	7190 MCF x 0.5	=	3595 MCF
June	-	5690 MCF	=	5690 MCF
July	-	4771 MCF	=	4771 MCF
Aug	-	5456 MCF	=	5456 MCF
Sept	-	5048 MCF	=	5048 MCF
				24560.5 MCF

Estimated Hot Water Consumption = 53,382 GPD

Q = 1 BTU/LB x 53,382 gal x 8.34 lb/gal x 60°F (BTU/LB) = 27,000 MBTU/day

Tank Losses:

Tank area = 100 sq. ft. with 2-inch insulation

Q_L = 7.5 Btu/Hr. Sf. 100 Sf. x 24 hr = 18000 Btu/day

x 83 bldgs. = 1494 MBtu/day

Total domestic hot water usage per day = 27,000 + 1494 = 28,494 MBtu/day

With 70% Boiler η = 40,705 MBtu/day

CF Gas = $\frac{40,705 \text{ MBtu}}{1000 \text{ Btu/CF}}$ = 40,705 CF/day

For 30 day month = 1221.2 MCF

Gas needed to generate and maintain the domestic hot water requirement from central plan

1221.2 MCF

Lowest recorded gas consumption by Central Plant = July, 1992

4771 MCF

Deduce that the difference is the system and line loss:

4771 - 1221.2 = 3549.8 = 3550 MCF/month

ECO METHODOLOGY FORM

ECO NAME:	Summer Shutdown of HTW System (Cont'd)
ECO NUMBER:	69
TYPE: BLDG SYSTEM:	North Distribution Heating
CALCULATION & COST METHODOLOGY:	

Conversion of buildings to on-site generation of hot water would eliminate Central Plant systems and line losses

3550 MCF/month

Water heaters would have 80% efficiency in lieu of 70% at Central Plant

$\frac{28{,}494 \text{ MBtu}}{0.8} = 35{,}617.5$ MBtu/day = 35,618 CF/day

35,617.5 x 30 days/mo = 1068.5 MCF/mo

Savings to increase efficiency = 1221.2 - 1068.5 = 152.7 MCF

Total Gas Savings Over 4-1/2 Months:

Line/system losses = 3550 MCF x 4.5 months	=	15,975 MCF
Increased Eff. = 152.7 MCF x 4.5 months	=	687 MCF
		16,662 MCF

Annual Cost Savings: Fuel For Operation Only

Fuel: 16,662 MCF x 1.03 Million Btu/mcf	=	17,161.86 MBtu
@ $0.45/therm	=	$ 77,228.37

Annual Additional Costs:

Labor shut down, isolate and reactivate Plants annually

1 hr per building: 81 manhours @ $25/mh = $2,025

Plant Manpower Savings

4.5 mo x 1 man at $25/hr x 30 days/mo x 24 hr/day	=	$81,000
Net Manhour Savings - (Annual Curring)	=	$79,975

Domestic Water Heater Calculations (Gas Vs. Heat Pump)

Heat pump - at 2.7 COP (minimum)

Electricity cost:

$\frac{\$.052/\text{KW}}{3413 \text{ Btu/hr} \times 2.7 \text{ COP}} = \$.0000056/\text{Btu}$

Natural Gas Cost:

$\frac{\$.45/100{,}000 \text{ Btu}}{.80 \text{ Eff}} = \$.0000056/\text{Btu}$

Therefore, cost of energy at Fort Gordon is the same for gas heating at 80% efficiency or with an electric heat pump at a 2.7 COP. But with heat pump, free cooling of space is:

$\frac{30{,}000 \text{ Btuh}}{12{,}000 \text{ Btu/ton}} = 2.5 \text{ ton} \times .75 \text{ KW/ton} \times \$.052/\text{KWH} = \$.0975/\text{hr}$

At 4-1/2 months x 30 days/month x 24 hrs/day x $.0975/hr = $315.90/yr

ECO METHODOLOGY FORM

ECO NAME: Summer Shutdown of HTW System (Cont'd)

ECO NUMBER: 69

TYPE: BLDG North Distribution
SYSTEM: Heating

CALCULATION & COST METHODOLOGY:

For 96 buildings:
Total savings is 96 x \$315.90 = \$30,326/yr. This savings would offset the additional cost of heat pumps vs. gas in buildings where heat pumps can be used to serve a useful purpose.

Savings on cooling load is therefore:
96 bldgs. x 2.5 tons x .75 KW/ton x 3413 Btu/KW ÷ 10^6 Btu/Million Btu = .614 Million Btu/hr

For 4.5 months x 30 days/mo. x 24 hours/day
.614 x 4.5 x 30 x 24 = 1990.46 Million Btu/yr.

<u>Cost for Heat Pump Installation</u>: (ECO 69A)

Cost of Heat Pumps in Buildings:

2-1/2 Ton Heat Pump			
Materials	\$192,000	Labor	\$24,000
Piping and Pumps (2) To Existing Domestic Hot Water Storage Tanks			
Materials	\$48,000	Labor	\$40,000
FCU in Building			
Materials	\$30,000	Labor	\$20,000
Electrical Work			
Materials	\$12,000	Labor	\$12,000

<u>Cost for Gas Heater Installation</u>: (ECO 69B)

Gas Piping x 96 Buildings			
Materials	\$30,000	Labor	\$60,000
Combustion Air Ventilation 96 Buildings			
Materials	\$ 5,000	Labor	\$ 9,600
Gas-Fired Water Heater (96) x			
Materials	\$20,000	Labor	\$12,400
Piping To Existing Storage Tanks			
Materials	\$30,000	Labor	\$25,000
Pumps 1 x 96			
Materials	\$ 9,600	Labor	\$ 5,000

ECO METHODOLOGY FORM

ECO NAME:	Summer Shutdown of HTW System (Cont'd)
ECO NUMBER:	69
TYPE: BLDG SYSTEM:	North Distribution Heating

CALCULATION & COST METHODOLOGY:

ECO 69C:

Because each type of building on the distribution system that is not yet equipped to generate domestic water heating in the cooling season must be individual analyzed for life cycle cost of heat pump vs. gas. This ECO must be analyzed three ways:

ECO 69A: Summer shutdown with heat pumps installed in 96 buildings that require individual domestic water heat generating equipment.

ECO 69B: Summer shutdown with gas-fired domestic water heaters installed in 96 buildings requiring local domestic water heating equipment.

ECO 69C: Since paybacks are similar for ECO 69A and ECO 69B, this ECO will take one half the cost of each and use the savings that would be derived if this is done.

Cost of ECO 69C - $\dfrac{514{,}609.20 + 290{,}226.20}{2} = \$402{,}417.70$

Savings:

Gas 17,161.56 Million Btu/yr.

Electric for cooling (1/2 computed value) $\dfrac{1990.46}{2}$ = 995.23 Million Btu/yr.

CONSTRUCTION COST ESTIMATE	DATE: 23 SEP 94	SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY		
Location: AUGUSTA, GEORGIA		PROJ. NO. 3
Arch/Engr: HARRISON AND SPENCER, INC.		CODE: NORTH DISTRIBUTION
Summary: ECO69a - SHUTDOWN W/ HEAT PUMPS	Estimator: H. TOUB	Checked:

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
2-1/2 TON HEAT PUMP (96 BUILDINGS)	1	LS	192000	192000	24000	24000	$216,000.00
PIPING & PUMPS TO EXIST TANKS	1	LS	48000	48000	40000	40000	$88,000.00
FCU IN BUILDING	1	LS	30000	30000	20000	20000	$50,000.00
ELECTRICAL WORK	1	LS	12000	12000	12000	12000	$24,000.00
	SUBTOTALS 1			$282,000.00		$96,000.00	$378,000.00
	5% SALES TAX			$14,100.00			$14,100.00
	17% LABOR TAX					$16,320.00	$16,320.00
	SUBTOTALS 2			$296,100.00		$112,320.00	$408,420.00
	20% GC OH & PROFIT						$81,684.00
SUB-CONTRACTORS	SUBTOTAL GC WORK						$490,104.00
	TOTAL SUB WORK						
	10% GC SUB PROFIT						
	5% CONTINGENCY ON JOB						$24,505.20
	TOTAL						$514,609.20

CONSTRUCTION COST ESTIMATE				DATE: 23 SEP 94			SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY							
Location: AUGUSTA, GEORGIA					PROJ. NO. 3		
Arch/Engr: HARRISON AND SPENCER, INC.					CODE: NORTH DISTRIBUTION		
Summary: ECO69b - SHUTDOWN W/ GAS		Estimator: H. TOUB			Checked:		
ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
GAS PIPING (96 BLDGS)	1	LS	30000	30000	60000	60000	$90,000.00
COMBUSTION AIR VENTILATION (96 BLDGS)	1	LS	5000	5000	9600	9600	$14,600.00
GAS FIRED WATER HEATER (96 BLDGS)	1	LS	20000	20000	12400	12400	$32,400.00
PIPING TO EXISTING STORAGE TANK	1	LS	30000	30000	25000	25000	$55,000.00
PUMPS (96 BLDGS)	1	LS	9600	9600	5000	5000	$14,600.00
	SUBTOTALS 1			$94,600.00		$112,000.00	$206,600.00
	5% SALES TAX			$4,730.00			$4,730.00
	17% LABOR TAX					$19,040.00	$19,040.00
	SUBTOTALS 2			$99,330.00		$131,040.00	$230,370.00
	20% GC OH & PROFIT						$46,074.00
SUB-CONTRACTORS	SUBTOTAL GC WORK						$276,444.00
	TOTAL SUB WORK						
	10% GC SUB PROFIT						
	5% CONTINGENCY ON JOB						$13,822.20
	TOTAL						$290,266.20

ECO METHODOLOGY FORM

ECO NAME:	Reduce Steam Leaks
ECO NUMBER:	71
TYPE: BLDG SYSTEM:	Bldg. 25910 Heating
EXISTING CONDITIONS:	Steam is leaking in some valves and through holes drilled in the cascade heaters. The total steam leakage is approximated at 50 lbs per hour, which is the equivalent of a half-inch hole at 14,000 ft. per minute steam flow.
PROPOSED CHANGE:	Weld the holes in the existing cascade heaters closed and replace the packing in leaking valve stems. Any other steam leak shall also be repaired. Even though we are using HTW only, leaks will still flash to steam.
CALCULATION & COST METHODOLOGY:	Estimated steam loss is:

$$\frac{50\ \text{lbs/hr} \times 24\ \text{hr/day} \times 365\ \text{days/yr} \times 910\ \text{Btus/lb}}{100{,}000\ \text{Btus/therm}} = 3{,}985.8/\text{therms}$$

or 398.58 Million Btu/Yr

$\$.45/\text{therm} \times 3{,}985.8/\text{therms} = \$1{,}793.61/\text{yr}$

Cost of Repairs:

50 hrs @ $25 = $1,250

CONSTRUCTION COST ESTIMATE	DATE: 23 SEP 94	SHEET 1 OF 1

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA — PROJ. NO. 3

Arch/Engr: HARRISON AND SPENCER, INC. — CODE: BLDG 25910

Summary: ECO71 - REDUCE STEAM LEAKS — Estimator: H. TOUB — Checked:

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
REPAIR STEAM LEAKS	50	HRS			25	1250	$1,250.00
	SUBTOTALS 1					$1,250.00	$1,250.00
	5% SALES TAX						
	17% LABOR TAX					$212.50	$212.50
	SUBTOTALS 2					$1,462.50	$1,462.50
	20% GC OH & PROFIT						$292.50
SUB-CONTRACTORS	SUBTOTAL GC WORK						$1,755.00
	TOTAL SUB WORK						
	10% GC SUB PROFIT						
	5% CONTINGENCY ON JOB						$87.75
	TOTAL						$1,842.75

ECO METHODOLOGY FORM

ECO NAME: EMCS Controls of Boiler and Chiller vs. Manual Control

ECO NUMBER: 88

TYPE: BLDG Bldg. 25910
SYSTEM: Heating

EXISTING CONDITIONS: Existing automatic or manual plant controls are located within the plant only with no EMCS tie-in for control. The EMCS office which is manned 24 hours a day has very few, if any instrumentation readouts from the plant, and no control of the Plant with the EMCS. Because EMCS personnel are aware of what is happening in many buildings, they are also aware of conditions and demands on the high temperature water system. Currently, the boiler operators are making boiler pressure changes, HTW changes, bringing on and off boilers, and many manual valving operations. However, they are not performing the functions that an EMCS office can to reduce the energy consumed and to improve the operating efficiency of the plant.

PROPOSED CHANGE: Connect most instrumentation and automatic controls and setpoint adjustments to the computerized EMCS system that is existing. EMCS personnel can then adjust HTW temperatures and temperature setpoints, and all new controls that may be added under other ECOs. All temperature, pressure and flow readings of new and existing instrumentation should be readable at the EMCS terminals. The individual that attends the Plant and that is not an EMCS operator shall have access to the readouts, but shall basically do maintenance most of the time, and turn on and off the equipment as required by the EMCS people.

CALCULATION & COST METHODOLOGY: Required EMCS controls and instrumentation for the high temperature water system at Building 25910 with new hot water generators.

DESCRIPTION	NO. POINTS	DOLLARS
Fuel flow	6	$ 9,000
Explosion tank temperatures and pressures	6	3,000
Combustion air and flue gas	6	2,000
HTW pump operation/temperature, pressure, flow	10	7,000
Make-up water temperature, pressure, flow	3	3,500
Nitrogen storage - level, temperature, pressure	4	3,600
Valve Positions	10	3,000
Btu computation	- -	2,500
Chemical feed	6	1,800
Hot water generator controls	6	3,000
Hot water generator combustion efficiency	- -	1,200
Gauges and dials	15	8,000
Total		$47,600

This assumes that no additional manpower will be required by EMCS personnel, nor will there be any reduction of personnel in the plant to operate the valves. However, the change that will take place will be that the EMCS personnel will actually have either physical control or the ability to tell people in the Plant to change valve positions to start or stop equipment.

The savings for this ECO is 3% of the total gas consumption used in Building 25910. This overall efficiency improvement is based on the fact that there will be better regulation of HTW temperatures. The hot water generator firing rate can be adjusted for predicted loads which the EMCS people will monitor and record, and also pumping speed regulation will be controlled by EMCS so that all buildings will be adequately served to get the required amount of HTW with a minimum amount of pumping energy used. Another savings would be the combustion controls regulations so that by monitoring the air flows and the oxygen

ECO METHODOLOGY FORM

ECO NAME:	EMCS Controls of Boiler and Chiller vs. Manual Control (Cont'd)
ECO NUMBER:	88
TYPE: BLDG SYSTEM:	Bldg. 25910 Heating
CALCULATION & COST METHODOLOGY:	in the flue gases some in the flue gases some regulation of the combustion of the new hot water generators will be available to be made by EMCS people either directly or by calling in the operator that is available in the Plant.

Calculation is $\frac{.03 \text{ x } 152{,}777 \text{ mcf x } 1{,}030{,}000 \text{ Btu's/mcf}}{10^6 \text{ Btu's/Million Btu's}}$ = 4,720.81 Million Btu's/yr.

CONSTRUCTION COST ESTIMATE	DATE: 23 SEP 94	SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY		
Location: AUGUSTA, GEORGIA	PROJ. NO. 4	
Arch/Engr: HARRISON AND SPENCER, INC.	CODE: BLDG 25330	
Summary: ECO88 - EMCS CONTROLS - HEATING	Estimator: H. TOUB	Checked:

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
FUEL FLOW	1	LS	4000	4000	2000	2000	$6,000.00
EXPANSION TANK	1	LS	1400	1400	600	600	$2,000.00
HTW PIPING	1	LS	2300	2300	2700	2700	$5,000.00
MAKE-UP WATER	1	LS	2000	2000	1500	1500	$3,500.00
NITROGEN	1	LS	1000	1000	1500	1500	$2,500.00
VALVE POSITIONS	1	LS	700	700	1300	1300	$2,000.00
BTU COMPUTATIONS	1	LS	500	500	2000	2000	$2,500.00
CHEMICAL FEED	1	LS	900	900	900	900	$1,800.00
HW GENERATOR PUMPS CONTROLS	1	LS	2000	2000	1000	1000	$3,000.00
HW GENERATORS COMBUSTION EFFICIENCY	1	LS	600	600	600	600	$1,200.00
GAUGES & DIALS	1	LS	2000	2000	2000	2000	$4,000.00
	SUBTOTALS 1			$17,400.00		$16,100.00	$33,500.00
	5% SALES TAX			$870.00			$870.00
	17% LABOR TAX					$2,737.00	$2,737.00
	SUBTOTALS 2			$18,270.00		$18,837.00	$37,107.00
	20% GC OH & PROFIT						$7,421.40
SUB-CONTRACTORS	SUBTOTAL GC WORK						$44,528.40
	TOTAL SUB WORK						
	10% GC SUB PROFIT						
	5% CONTINGENCY ON JOB						$2,226.42
	TOTAL						$46,754.82

HEATING REQUIREMENTS DATA SUMMARY - BUILDING 25910:

INTRODUCTION:

Heat load requirements for the North Central Utility Plant were determined from field survey data. The data was analyzed using the Trane Trace 600 Load calculation program. The data reported in Tables 3A, 3B, and 3C are the results of the analysis. The data files produced from the Trace 600 program are contained in Appendix I. Load calculations were run for the 36 building types that represent all the building types serviced by the North Central Plant. These building types represent 86 total buildings serviced on the north side of the base from Building 25910. The following commentary explains the data contained in each of the tables.

Table 3A - Heating Profile - Building Types serviced by North Central Utility Plant-Building 25910

Each building type (36 total), as defined in the field survey, is listed across the top of the table. Values are recorded for every hour for twenty four hours. There are twelve sections to the table, one for each month of the year. Each entry is in thousands of BTU/hr. Table 3A therefore contains heating requirements for each building type for every hour of the day for all twelve months of the year in thousands of BTU's per hour (MBTUH). The last column on the right contains the total MBTUH values for each building type for a particular hour. The data shows that the loads are highest during the winter months of December, January, and February. As you proceed into spring, loads diminish and the hours requiring heat become less. As you proceed into the summer months you may see some shall loads reported. Keeping in mind that we are reporting loads in thousands of BTU's, the values are very small and are dropped in later calculations.

Table 3B - Heating Profile - Total of All Buildings Serviced By North Central Utility Plant-Building 25910

Some of the building types surveyed are representative of multiple buildings of the same type. Table 3B accounts for multiple buildings by building type. The totals column therefore is representative of the true hourly loads for each month. Building types representing more than one building are: Type 1A-6 buildings, Type 1B-3 buildings, Type 3A-9 buildings, Type 3B-3 buildings, Type 4A-17 buildings, Type 4B-10 buildings, Type 7-2 buildings, Type 8-2 buildings, Type 9-3 buildings, and Type 12-2 buildings. All the rest of the building types represent a single building each. There are a total of 84 buildings serviced by the Central Utility Plant Building 25910.

Table 3C - Heat Load Requirement Summary - North Utility Plant

This table is a compilation of the totals columns taken from Table 3B for each month. This Table provides a means to estimate plant heating load requirements on the hot water generating equipment at the North Plant.

SUMMARY:

All the data recorded in Table 3 (A, B & C) was derived from field survey information and the Trace 600 load calculations. See Appendix I for a complete printout of all generated data. The values appearing in Table 3A were taken directly from the Trace output data.

HEATING PROFILE - BUILDINGS SERVICED BY NORTH CENTRAL UTILITY PLANT - BUILDING 25910

JANUARY

DAY	BUILDING TYPE																																			
HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	146	183	141	250	150	131	527	422	336	360	271	199	130	55	528	1292	1634	404	1291	1413	332	457	451	90	2995	714	612	714	355	789	336	448	283	322	363	1039	20028
2	149	187	144	258	153	135	559	450	342	366	277	206	134	55	550	1372	1681	428	1318	1478	354	470	465	96	3056	721	618	721	393	811	345	467	284	321	365	1057	20721
3	151	188	145	264	159	141	580	466	342	366	278	214	136	55	563	1436	1703	441	1319	1530	370	480	464	101	3084	714	612	714	396	840	353	483	280	315	359	1062	21060
4	150	186	145	261	160	142	607	485	336	359	273	214	136	53	557	1472	1702	450	1300	1524	377	482	458	103	3062	695	596	695	401	842	354	483	271	304	348	1055	20986
5	150	184	144	258	162	144	628	499	326	348	267	215	134	51	546	1513	1682	453	1263	1553	391	478	448	107	3001	667	573	667	409	847	357	482	260	291	333	1038	20825
6	146	178	144	253	160	143	637	507	312	333	256	214	127	48	531	1542	1645	454	1210	1562	400	475	433	110	2903	632	542	632	418	830	356	482	246	274	315	1009	20423
7	141	172	142	247	159	143	638	502	296	316	244	211	120	44	514	1544	1600	452	1151	1537	406	463	417	111	2788	595	510	595	428	818	347	482	231	258	296	976	19866
8	136	164	140	240	153	138	639	496	278	296	230	204	112	41	491	1542	1539	445	1080	1507	403	442	398	111	2656	553	574	553	436	792	337	480	215	241	276	935	19249
9	118	145	120	220	142	129	616	453	257	273	211	180	104	37	461	1490	1464	430	1002	1413	382	410	378	108	2392	510	436	510	442	746	314	475	199	224	254	888	17921
10	101	126	96	211	128	115	575	397	233	248	191	160	94	33	417	1460	1369	417	916	1343	355	373	357	105	2156	465	397	465	441	690	296	166	182	208	231	836	16337
11	82	106	70	202	108	96	522	309	210	223	168	134	85	29	355	1368	1251	392	820	1207	318	328	336	96	1906	420	358	420	434	622	267	452	165	193	209	781	14962
12	70	93	49	193	89	79	485	257	188	200	147	113	76	26	287	1269	1115	366	720	1106	283	289	316	88	1704	376	322	376	420	556	246	433	149	179	188	725	13411
13	60	83	33	136	74	64	433	197	167	180	130	91	68	23	229	1137	982	329	630	963	242	249	298	78	1524	339	290	339	375	487	229	310	136	168	170	584	11700
14	51	72	21	81	60	51	377	143	148	164	115	71	62	20	179	1001	858	286	552	828	203	213	283	67	1361	307	264	307	230	425	206	254	127	158	156	480	10100
15	47	68	20	57	51	42	333	104	136	148	104	58	58	18	140	867	752	251	494	725	173	185	272	60	1257	285	246	285	183	379	190	224	121	152	146	448	9022
16	46	66	23	53	47	38	291	84	128	140	97	48	55	18	114	752	666	221	456	637	146	171	226	50	1190	272	235	273	156	344	170	189	118	148	140	444	8199
17	51	71	39	58	52	43	261	86	130	142	99	47	56	18	109	702	633	210	457	617	133	173	213	44	1214	281	243	281	130	334	165	184	122	153	145	483	8121
18	65	85	60	76	65	56	278	130	142	156	107	59	62	21	128	679	658	202	498	650	139	191	223	43	1351	310	268	311	136	355	171	192	134	165	161	544	8795
19	78	100	75	124	79	68	286	164	166	181	127	80	71	25	176	700	749	216	586	714	154	220	247	46	1552	362	312	362	155	397	181	213	153	186	187	631	9999
20	89	114	88	178	91	79	325	202	198	215	154	100	83	31	237	797	895	247	708	806	183	260	278	50	1803	427	367	427	187	462	207	241	178	212	221	718	11380
21	102	129	101	212	103	90	348	249	232	251	182	122	96	37	304	864	1074	272	852	946	212	307	318	58	2094	500	430	500	218	530	234	281	206	242	259	810	13569
22	115	146	113	225	117	102	405	295	266	288	211	145	110	43	372	1000	1250	313	993	1075	242	347	360	66	2380	571	490	571	248	611	262	331	233	270	295	893	15546
23	127	161	123	236	127	111	441	334	297	320	236	164	115	48	438	1090	1417	344	1124	1197	274	388	396	74	2636	637	546	637	289	669	285	374	257	296	327	953	17308
24	138	174	133	245	138	120	486	386	322	345	257	183	123	52	489	1187	1545	375	1225	1323	309	426	429	84	2930	686	588	686	329	735	313	408	274	313	351	1002	18973

FEBRUARY

DAY	BUILDING TYPE																																			
HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	117	146	116	222	122	108	449	356	260	281	206	157	107	41	396	1064	1275	330	990	1148	282	364	360	76	2371	548	475	548	311	637	267	368	217	259	284	869	16216
2	125	156	123	230	130	115	475	378	281	302	224	168	115	45	435	1150	1393	355	1079	1228	302	396	388	81	2532	594	514	594	334	692	290	394	234	276	306	910	17331
3	133	166	131	237	139	122	515	413	301	322	241	184	123	48	474	1237	1506	380	1163	1338	333	422	414	87	2715	637	550	637	358	737	309	434	250	293	326	951	18612
4	139	173	135	242	145	128	530	430	316	338	254	192	128	51	504	1311	1598	402	1230	1398	347	441	434	91	2835	671	577	671	380	770	322	454	262	305	342	986	19517
5	146	181	143	257	153	135	571	463	328	351	267	207	134	53	530	1391	1679	426	1285	1475	368	469	445	99	2953	698	600	698	396	819	339	476	272	315	354	1016	20464
6	149	185	144	261	157	139	596	479	335	359	273	214	137	54	553	1453	1735	443	1321	1522	390	482	453	103	3023	713	613	713	400	841	353	480	278	320	361	1038	21039
7	152	188	145	264	163	145	617	507	339	362	277	217	138	54	570	1524	1776	457	1341	1578	406	495	457	108	3078	720	619	720	408	864	363	485	280	322	364	1052	21519
8	151	186	145	263	163	145	632	512	335	358	275	219	137	53	569	1569	1777	463	1329	1588	414	490	454	110	3057	709	609	709	417	869	364	490	276	316	357	1050	21220
9	135	170	142	258	156	138	627	473	321	343	262	201	131	50	549	1565	1727	459	1276	1532	398	473	444	110	2872	677	582	677	424	839	344	490	262	301	339	1027	20730
10	119	153	110	236	141	125	601	429	297	318	241	185	123	46	508	1530	1623	448	1184	1484	383	444	425	108	2667	627	539	627	425	800	328	486	241	280	313	983	19543
11	102	135	85	225	125	110	578	379	268	287	215	162	112	41	447	1474	1479	429	1065	1395	365	405	401	104	2422	565	487	565	423	751	307	476	215	256	280	926	18020
12	87	119	66	212	109	95	547	327	238	254	187	138	100	36	376	1382	1311	403	930	1279	324	356	373	97	2157	496	429	496	414	681	287	460	189	229	246	859	16174
13	72	102	42	200	87	75	500	258	208	222	160	110	87	30	307	1220	1134	362	793	1093	280	298	345	86	1867	426	370	426	375	584	257	397	163	203	211	787	13968
14	61	88	29	164	71	60	443	214	175	193	135	87	75	25	243	1072	959	314	664	962	240	253	317	77	1648	359	314	359	256	506	233	296	139	178	178	592	11728
15	51	76	20	96	59	50	399	164	151	167	115	66	66	21	192	915	816	271	566	825	203	213	295	65	1430	308	272	308	206	439	203	246	122	160	154	508	10142
16	50	73	24	65	53	44	360	148	134	147	104	54	60	18	152	801	704	237	496	736	181	198	246	56	1296	274	244	274	171	399	186	226	111	148	139	482	9046
17	52	73	32	60	55	46	322	138	129	140	101	50	57	17	132	708	634	213	463	682	162	184	221	50	1245	262	234	263	159	384	173	203	108	146	134	480	8474
18	59	79	48	64	61	52	306	155	130	142	102	53	58	18	127	661	609	197	464	651	158	186	217	44	1270	269	241	269	155	371	161	197	111	150	138	510	8444
19	69	89	67	87	75	65	307	181	136	148	106	71	61	20	140	664	620	204	487	684	166	210	224	47	1380	285	255	285	166	398	169	209	117	157	148	571	9016
20	77	97	76	118	82	73	321	214	150	164	114	86	66	22	176	700	682	213	540	732	180	230	238	48	1507	314	280	314	185	426	180	228	129	168	164	612	9863
21	84	106	85	153	90	80	332	243	168	184	126	98	72	25	217	749	772	228	611	791	202	250	257	51	1665	350	311	351	202	457	193	247	143	182	183	658	10877
22	91	114	92	192	98	86	351	270	190	207	146	113	80	29	266	816	888	252	699	888	217	280	283	58	1842	396	350	397	233	506	213	280	160	200	208	719	12173
23	100	125	98	205	106	93	386	295	213	231	166	127	89	33	311	893	1011	277	792	971	239	307	305	64	2014	445	390	445	246	540	227	309	179	219	232	769	13440
24	107	134	106	214	113	99	413	318	236	256	186	144	98	37	354	982	1144	303	892	1059	260	336	334	70	2192	497	433	497	274	588	247	339	198	239	258	827	14774

Table 3A - 1

MARCH

DAY	BUILDING TYPE																																				
HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	71	91	70	155	43	33	174	179	140	153	109	85	63	23	164	441	525	132	523	592	134	211	213	30	1489	280	266	280	9	362	142	171	103	143	150	567	8915
2	81	104	81	192	56	45	215	216	163	180	122	102	74	28	228	560	699	162	641	712	158	248	248	39	1689	344	317	344	136	416	165	213	127	166	180	641	10092
3	90	114	89	201	88	76	251	249	191	210	141	118	82	32	273	644	835	213	734	797	185	273	276	45	1877	393	357	393	174	471	188	240	146	183	204	699	11444
4	98	125	96	208	97	84	294	281	215	234	164	129	89	35	311	748	948	244	811	897	205	303	302	53	2044	432	389	432	198	512	205	276	161	197	222	749	12788
5	103	130	102	212	103	90	316	299	230	249	178	137	93	37	336	849	1031	269	860	964	231	320	319	58	2138	455	406	455	235	554	224	299	169	203	231	775	13560
6	107	135	105	214	111	97	356	327	238	257	186	149	94	37	355	912	1086	288	887	1022	247	334	334	65	2200	466	413	466	258	578	235	331	173	204	235	801	14313
7	107	134	107	213	113	100	372	338	237	256	187	150	94	36	361	977	1098	304	878	1047	256	339	335	68	2198	456	402	456	278	585	243	343	168	197	228	789	14450
8	96	121	97	209	109	96	386	329	224	243	177	138	88	33	350	1002	1067	306	833	1019	258	330	325	69	2046	426	375	426	285	577	226	334	155	182	211	735	13883
9	78	102	73	200	98	86	375	299	200	217	157	123	80	29	315	993	981	296	746	963	247	305	305	70	1832	376	332	376	272	555	211	329	134	159	184	651	12749
10	57	81	42	183	78	68	353	237	168	183	130	100	68	24	258	950	850	275	628	864	227	264	273	64	1559	313	278	313	252	492	184	291	108	133	150	532	11070
11	35	59	13	104	55	46	310	166	130	143	98	64	54	18	187	840	684	241	486	721	184	209	235	55	1232	239	215	239	198	407	152	234	77	104	110	410	8834
12	17	39		29	38	31	271	111	99	109	77	33	39	11	106	686	489	195	332	542	141	148	190	46	912	158	147	158	135	317	119	164	45	73	68	285	6360
13	12	24		12	30	24	213	52	77	84	60	8	25	5	31	510	293	147	186	393	95	94	148	35	637	80	83	80	79	225	93	105	17	44	30	180	4211
14	7	8			20	15	168	7	55	61	43		13			333	109	98	56	214	46	41	107	21	358	11	26	11	20	135	64	39		19		80	2185
15	4	5			11	8	119		39	43	30		3			182		53		101	21	13	71	11	184					81	37	13				24	1053
16	2	3			5	3	69		28	31	21		2			52		23		12			43	2	44					37	12						389
17	3	4			1		33		24	27	18		1					5					25							13							154
18	6	6			2		19		27	30	20		1										21							15						15	162
19	11	10			9	5	10		35	38	26		1										30		161					32						109	477
20	22	14			14	10	24		47	52	36		7					13					48		333					69	10			16		180	895
21	18	32			19	15	50		63	69	48		16					34				58	76		538		37			121	35			38		248	1515
22	23	50		10	26	20	71		80	87	62		27	5				54	114	199	20	100	107		759	66	91	66		172	62		15	63	37	322	2708
23	28	63		55	30	23	94	74	100	109	77		39	12		142	95	80	255	309	73	134	142		985	141	151	141		230	86	27	46	91	77	401	4310
24	52	78	22	110	37	28	139	141	120	131	93	45	51	18	65	318	321	107	391	452	100	170	177	20	1243	214	210	214		303	112	135	75	118	115	488	6413

APRIL

DAY	BUILDING TYPE																																				
HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	7	11							69	76	53		16					59													61						375
2	20	50		23					84	92	64		28	1				76							89						5						569
3	40	60		62	13				97	107	74		34	6				8	117				132		962		62									89	1902
4	52	69	43	101	30	11			109	120	84	49	41	10	71		81	92	228			107	163		1124	16	110	16		184				15	21	415	3391
5	59	76	59	130	34	25			118	129	91	73	46	14	126		263	111	316			176	182		1230	77	146	77		295			3	38	50	452	4416
6	63	81	65	150	38	29		128	124	135	96	81	49	16	158	280	392	122	378			191	200		1307	121	170	121		322	76		23	54	70	470	5509
7	63	81	64	149	40	31		184	128	142	97	83	51	17	174	511	482	156	419	106	23	198	207		1326	150	185	150		338	128		37	64	82	475	6312
8	51	69	47	120	39	31	148	170	125	139	94	75	50	17	166	550	500	172	411	457	134	197	204		1256	152	178	152		344	123		39	63	80	433	6740
9	35	53	20	74	33	25	161	131	107	117	83	64	42	13	125	529	426	160	339	411	127	179	184	26	1092	121	144	121		318	107	67	25	48	60	349	5861
10	12	30		19	25	18	135	68	84	93	65	34	30	8	64	457	280	130	218	335	101	132	149	27	777	63	90	63		258	71	132		22	27	217	4217
11		8		2	14	10	102	12	58	64	44	3	14	1		323	84	89	62	223	64	74	106	18	435		21			176	35	71				91	2202
12					5	2	56		31	35	23		1			156		41		32	23	21	59	8	112					85		14					704
13									5	6	2									4			12														29
14															6																						6
15																																					0
16																																					0
17																																					0
18																																					0
19																																					0
20																																					0
21		5																		65					60												130
22		11			5																	19			262												297
23		1							24	32		9						10		49		53			492						15						685
24									53	58	40		5					36		140		5			32						39						408

Table 3A – 2

MAY

DAY HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	5	12																23				8			252												300
2	1	1			4							8						45		9		39			448												555
3									24	40			3					62		111		74			646						25						985
4		2							61	68	30		12					12				6			39						48						248
5	8	36		23					71	78	53		18					36													65						335
6	30	48		44					78	85	59		22					71					44		178						5						635
7	31	44		44	6				79	87	60	3	24					68	50				116		767												1372
8	18	30		19	17				74	81	56	24	22					57	58			42	112		657											38	1328
9	3	15		1	10				57	63	43	14	13					35				69	89		488					140						131	1188
10		2							33	37	23							8				30	48		146					80							440
11									4	5													4														56
12																																					23
13																																					0
14																																					0
15																																					0
16																																					0
17																																					0
18																																					0
19																																					0
20																																					0
21																																					0
22																																					0
23																																					0
24		5																							15												20

JUNE

DAY HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1																																					0
2																																					0
3																																					0
4																									151												151
5																						12			245												257
6																						24			295												319
7																						12			221												233
8																									53												53
9																																					0
10																																					0
11																																					0
12																																					0
13																																					0
14																																					0
15																																					0
16																																					0
17																																					0
18																																					0
19																																					0
20																																					0
21																																					0
22																																					0
23																																					0
24																																					0

Table 3A - 3

JULY

DAY / HOUR	BUILDING TYPE 1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1																																					0
2																																					0
3																									45												45
4																									133												133
5																									203												203
6																									245												245
7																									167												167
8																																					0
9																																					0
10																																					0
11																																					0
12																																					0
13																																					0
14																																					0
15																																					0
16																																					0
17																																					0
18																																					0
19																																					0
20																																					0
21																																					0
22																																					0
23																																					0
24																																					0

AUGUST

DAY / HOUR	BUILDING TYPE 1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1																																					0
2																																					0
3																																					0
4																									108												108
5																		8							201												209
6																		14		14					272												300
7																		19		38					291												348
8																		11							213												224
9																									23												23
10																																					0
11																																					0
12																																					0
13																																					0
14																																					0
15																																					0
16																																					0
17																																					0
18																																					0
19																																					0
20																																					0
21																																					0
22																																					0
23																																					0
24																																					0

Table 3A - 4

SEPTEMBER

DAY HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	4	9																21							143												177
2		1			5													38				21			339												404
3	10								2	15								57		73		47			493						18						715
4	29								46	51	9							11		151		4			30						39						370
5	20	11							55	60	41		7					15													54						263
6	3	33		6					60	66	46		11					55													4						284
7		39		9					63	69	48		13					57					48		342												688
8		29		1	17				58	63	44		11					47					84		528												882
9		11		1	11				45	50	34		5					42					68		339												606
10					3				24	27	18							12					38														122
11																																					0
12																																					0
13																																					0
14																																					0
15																																					0
16																																					0
17																																					0
18																																					0
19																																					0
20																																					0
21																																					0
22																																					0
23																																					0
24		2																2																			2

OCTOBER

DAY HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	63	82	65	141	40	31	143		132	145	102	64	56	19	118	421	445	125	431	462		179	203		1333	214	212	214		306	124		81	108	114	505	6267
2	73	93	74	182	45	34	183	31	147	161	114	85	64	23	186	532	612	159	538	602	34	213	230	30	1528	270	256	270		364	149	101	102	128	141	565	7781
3	80	103	79	193	49	38	207	211	171	189	124	100	69	26	226	612	744	203	625	699	143	236	257	39	1667	316	292	316		404	165	206	118	144	162	605	9193
4	87	111	87	199	55	43	245	232	191	209	143	110	75	29	258	722	849	233	693	780	163	264	276	47	1814	351	319	351		453	186	233	131	156	178	651	10231
5	93	117	92	203	58	46	282	261	204	222	156	123	81	30	284	792	928	252	740	861	189	280	293	51	1900	374	336	374	174	482	199	264	139	163	188	686	11177
6	97	121	97	205	73	60	325	292	212	230	165	132	84	31	304	869	980	272	676	930	209	302	307	59	1991	387	345	387	234	521	216	290	144	166	193	715	11945
7	96	120	96	203	100	88	341	301	208	226	163	131	81	30	304	908	973	281	748	949	218	298	306	62	1944	374	333	374	254	524	218	300	138	158	185	695	11980
8	83	105	85	196	94	83	335	286	190	206	149	118	74	26	279	922	901	280	675	895	216	282	289	63	1751	331	294	331	245	493	199	296	120	137	161	631	11146
9	61	81	59	166	80	70	314	234	158	171	122	94	61	21	228	893	762	263	548	810	195	238	256	60	1463	260	233	260	224	437	173	268	90	106	123	512	9546
10	37	55	26	82	55	48	268	156	116	126	87	68	45	14	149	800	573	232	385	682	169	186	213	53	1093	174	159	174	197	366	141	221	55	70	78	380	7348
11	13	29		20	35	29	221	79	81	88	64	29	28	6	58	677	360	190	208	498	115	119	166	44	706	82	80	82	133	258	102	152	19	33	30	230	4856
12	5	6		3	25	21	158		54	58	42		11			513	144	141	35	291	57	51	116	31	345		5		66	145	68	77				84	2517
13		1			15	13	100		30	33	23		3			335		90		114	12		72	17	41				11	54	37	15					1016
14					6	5	47		14	15	10		2		5	147		40		29			34	6							15						375
15									7	8	4		1			12		5					8														45
16									7	8	5		1																								21
17									12	13	8																										33
18		2							21	24	15																										62
19	7	17							33	36	25												14														132
20	19	30			11	1			48	53	36	4	4										44														250
21	16	17			18	13			65	71	49		14					35					74		281									14		175	842
22	21	21		9	23	17			82	90	63		25	3				57	38				106		719	17	52	17			20		3	40	9	303	1697
23	25	52		55	28	20			100	109	77		36	9			16	79	181			44	140		927	92	110	92		191	76		32	66	49	368	2793
24	44	71	21	105	33	25	15		117	128	90		46	14	28	301	253	102	313	287		150	171		1150	161	165	161		255	103		59	90	84	438	4667

Table 3A – 5

NOVEMBER

DAY	BUILDING TYPE																																			
HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	67	86	68	150	43	33	185	113	136	148	105	80	60	22	144	535	642	175	505	567	109	191	213	32	1412	268	243	269	64	327	140	161	112	133	141	529	8208
2	78	100	78	193	50	39	227	193	159	176	119	92	71	27	208	632	789	207	621	682	140	228	246	38	1609	331	294	331	134	390	166	200	134	156	171	603	9912
3	87	111	87	202	84	72	268	227	188	206	139	108	79	30	255	722	913	233	719	772	161	262	274	46	1806	382	336	382	172	438	186	229	152	174	195	664	11361
4	94	120	94	209	92	79	293	261	213	232	163	123	86	34	296	818	1024	258	804	872	190	292	301	53	1984	426	373	426	193	491	208	265	167	190	216	720	12560
5	103	129	100	214	99	85	329	280	230	250	179	132	89	36	327	893	1109	282	868	962	207	312	321	59	2101	457	399	457	230	538	223	289	178	201	230	754	13652
6	107	135	105	217	107	93	365	309	243	263	191	144	94	37	352	963	1172	302	912	1023	233	328	339	65	2190	478	415	478	251	567	235	320	184	207	239	789	14362
7	110	138	108	219	111	97	385	336	249	269	196	152	97	38	368	1033	1209	320	932	1068	247	347	348	69	2268	485	421	485	284	587	249	338	186	208	241	807	15005
8	108	135	108	216	114	100	411	341	244	263	193	149	96	36	365	1074	1191	329	906	1089	255	340	348	72	2203	468	406	468	298	602	250	347	178	198	231	790	14922
9	90	115	89	208	102	89	390	303	220	238	174	129	87	32	329	1076	1092	325	814	1018	243	313	326	72	1954	412	358	412	276	554	227	330	155	173	201	704	13630
10	66	89	58	194	82	71	352	231	184	199	144	103	73	25	262	1021	929	301	670	929	218	264	292	69	1632	331	290	331	251	491	204	288	122	138	159	577	11640
11	46	66	29	113	61	52	307	159	139	151	106	73	55	17	170	926	702	269	481	770	182	203	245	60	1285	230	204	230	208	402	174	238	82	96	107	438	9014
12	26	43	3	26	43	37	245	82	97	106	77	40	36	9	74	781	457	222	280	586	133	140	197	51	892	126	116	126	156	296	140	176	42	54	54	297	6204
13	17	23		9	33	28	187	20	67	73	53	14	18	1		612	218	172	88	401	78	75	140	40	550	27	32	27	102	184	105	114	6	15	5	170	3932
14	10	10			23	20	123		42	46	34		4			428	24	118		222	32	21	92	25	214				35	92	68	42				66	1749
15	6	6			13	12	64		25	27	20		3			276		76		63			55	13						13	36						708
16	5	5			8	7	9		18	20	14		2			154		44		22			32	4							19						363
17	6	6			7	6			19	20	14		1			114		30		9			24								9						265
18	9	9			13	11			25	28	20		1			80		25					30								16					37	304
19	16	11			16	13	18		36	39	28		1			101		31		3			41								23					127	504
20	15	14			20	17	41		48	52	37		7			148		48		10			62	3	359					40	37			6		185	1149
21	18	26		6	22	17	63		63	69	49		16			199		66		187		5	89	8	527		14			110	53		10	30		243	1890
22	23	48	29	17	28	22	89		80	88	62		27	5		265	125	89	115	283		91	117	14	738	65	74	65		166	75		37	57	38	320	3252
23	28	61	48	56	31	24	113		98	108	76		38	11		351	307	117	249	374	7	128	148	20	972	137	132	137		218	96	99	64	83	75	380	4786
24	58	74	58	109	37	29	150		118	128	91	53	49	17	51	450	482	146	382	478	88	162	182	26	1185	208	191	208		276	119	133	90	109	110	458	6505

DECEMBER

DAY	BUILDING TYPE																																			
HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	100	126	98	211	101	88	345	268	227	246	178	130	91	35	317	901	1079	284	834	958	211	306	316	62	2047	457	393	457	231	532	228	299	184	207	233	768	13488
2	109	136	106	217	109	95	385	303	246	266	194	145	98	38	353	986	1183	308	911	1041	241	330	338	67	2020	496	426	496	266	574	246	326	198	221	251	820	14545
3	114	143	112	223	116	101	416	335	261	282	208	154	103	41	383	1061	1273	330	976	1122	257	356	357	72	2337	527	453	527	288	608	259	348	209	233	266	852	15703
4	119	149	116	227	122	107	439	352	273	295	218	162	107	42	410	1120	1348	347	1030	1183	283	374	376	76	2437	552	474	552	309	649	277	378	218	242	278	886	16527
5	123	153	122	229	127	111	473	382	281	302	225	170	110	43	429	1184	1397	364	1062	1233	297	388	388	82	2506	566	485	566	330	673	287	397	222	246	284	898	17135
6	126	156	123	230	141	116	494	395	285	305	228	176	112	44	441	1243	1428	379	1078	1280	311	399	396	86	2552	572	489	572	364	693	296	415	224	248	286	903	17586
7	127	156	127	228	135	120	515	411	281	300	226	182	111	42	442	1292	1424	391	1062	1318	325	406	395	90	2556	560	478	560	384	705	302	432	218	241	279	895	17716
8	123	151	123	223	133	119	517	418	267	285	215	180	104	40	425	1299	1369	390	1004	1298	333	395	380	92	2458	524	447	524	387	697	294	428	203	225	259	867	17196
9	106	132	109	214	123	110	497	374	242	259	194	157	94	35	389	1276	1263	377	904	1220	310	360	356	89	2203	465	397	465	366	646	276	410	180	199	229	817	15843
10	85	108	82	202	105	94	457	306	207	224	166	131	82	29	335	1214	1117	356	775	1114	286	312	326	86	1886	392	336	393	339	585	247	368	151	169	192	719	16976
11	64	85	54	184	83	73	401	229	170	186	134	102	68	23	260	1137	945	328	629	975	247	260	294	78	1550	315	271	315	295	502	219	317	121	139	153	554	11460
12	45	64	26	97	62	53	342	146	135	146	105	73	54	17	176	997	765	286	484	806	198	204	260	68	1247	242	209	242	240	409	188	255	93	112	116	432	9394
13	33	50	9	31	48	41	281	82	105	115	82	50	43	12	104	874	601	251	358	654	147	151	215	59	1004	182	158	182	188	318	163	202	72	91	87	335	7378
14	27	39		23	40	34	235	27	91	98	72	27	34	8	52	720	473	208	267	511	107	110	180	47	803	141	123	141	133	249	142	148	60	78	68	274	5790
15	26	35		20	34	28	188	5	85	93	67	12	31	7	21	613	396	176	224	420	81	95	159	38	700	127	111	127	93	212	122	114	57	76	63	252	4908
16	26	36		20	30	25	145		85	92	66	3	31	7	6	525	350	156	210	355	54	76	145	29	654	129	113	129	52	181	108	80	61	80	66	257	4382
17	29	44	22	22	32	25	144		89	97	69	8	33	8		469	325	138	216	348	46	86	145	26	718	140	124	140	49	190	101	81	66	87	72	304	4493
18	34	56	40	25	37	30	148	14	96	105	75	26	37	10		455	327	137	239	378	57	106	149	26	872	159	141	159	61	212	108	95	74	95	82	363	5028
19	51	66	53	35	41	34	155	67	106	116	83	41	42	13	36	474	377	146	290	425	72	128	164	26	1012	189	166	189	66	232	119	114	85	105	98	419	5835
20	59	75	60	75	45	37	191	110	118	129	93	58	50	17	88	519	474	162	370	493	97	158	187	32	1162	229	200	229	97	281	132	137	100	120	119	474	6977
21	67	85	69	114	61	52	217	140	133	147	102	73	57	21	138	585	586	186	457	578	110	187	208	35	1334	271	236	271	113	328	151	167	116	136	141	517	8189
22	74	95	76	155	75	65	243	169	159	174	116	88	66	25	186	644	713	205	554	677	145	218	236	42	1516	319	277	319	142	380	166	201	133	154	165	591	9563
23	83	105	84	193	84	73	281	208	183	199	139	102	74	28	231	736	839	231	652	767	168	246	262	48	1693	367	317	367	181	429	191	231	151	172	188	647	10950
24	92	116	91	204	92	80	316	243	205	222	158	118	83	32	273	812	959	159	743	847	188	272	287	53	1883	412	355	412	205	473	209	258	167	190	211	704	12124

Table 3A – 6

HEATING PROFILE - BUILDINGS SERVICED BY NORTH CENTRAL UTILITY PLANT - BUILDING 25910

JANUARY

DAY	BUILDING TYPE																																			
HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	876	549	141	250	1350	393	8959	4220	336	360	271	398	260	110	1584	1292	1634	808	1291	1413	332	457	451	90	2995	714	612	714	355	789	336	448	283	322	363	1039	36795
2	894	561	144	258	1377	405	9503	4500	342	366	277	412	268	110	1650	1372	1681	856	1318	1478	354	470	465	96	3056	721	618	721	393	811	345	467	284	321	365	1057	38316
3	906	564	145	264	1431	423	9860	4660	342	366	278	428	272	110	1689	1436	1703	882	1319	1530	370	480	464	101	3084	714	612	714	396	840	353	483	280	315	359	1062	39235
4	900	558	145	261	1440	426	10319	4850	336	359	273	428	272	106	1671	1472	1702	900	1300	1524	377	482	458	103	3062	695	596	695	401	842	354	483	271	304	348	1055	39768
5	900	552	144	258	1458	432	10676	4990	326	348	267	430	268	102	1638	1513	1682	906	1263	1553	391	478	448	107	3001	667	573	667	409	847	357	482	260	291	333	1038	40055
6	876	534	144	253	1440	429	10829	5070	312	333	256	428	254	96	1593	1542	1645	908	1210	1562	400	475	433	110	2903	632	542	632	418	830	356	482	246	274	315	1009	39771
7	846	516	142	247	1431	429	10846	5020	296	316	244	422	240	88	1542	1544	1600	904	1151	1537	406	463	417	111	2788	595	510	595	428	818	347	482	231	258	296	976	39082
8	816	492	140	240	1377	414	10863	4960	278	296	230	408	224	82	1473	1542	1539	890	1080	1507	403	442	398	111	2656	553	574	553	436	792	337	480	215	241	276	935	38253
9	708	435	120	220	1278	387	10472	4530	257	273	211	360	208	74	1383	1490	1464	860	1002	1413	382	410	378	108	2392	510	436	510	442	746	314	475	199	224	254	888	35813
10	606	378	96	211	1152	345	9775	3970	233	248	191	320	188	66	1251	1460	1369	834	916	1343	355	373	357	105	2156	465	397	465	441	690	296	166	182	208	231	836	32675
11	492	318	70	202	972	288	8874	3090	210	223	168	268	170	58	1065	1368	1251	784	820	1207	318	328	336	96	1906	420	358	420	434	622	267	452	165	193	209	781	29203
12	420	279	49	193	801	237	8245	2570	188	200	147	226	152	52	861	1269	1115	732	720	1106	283	289	316	88	1704	376	322	376	420	556	246	433	149	179	188	725	26212
13	360	249	33	136	666	192	7361	1970	167	180	130	182	136	46	687	1137	982	658	630	963	242	249	298	78	1524	339	290	339	375	487	229	310	136	168	170	584	22683
14	306	216	21	81	540	153	6409	1430	148	164	115	142	124	40	537	1001	858	572	552	828	203	213	283	67	1361	307	264	307	230	425	206	254	127	158	156	480	19278
15	282	204	20	57	459	126	5661	1040	136	148	104	116	116	36	420	867	752	502	494	725	173	185	272	60	1257	285	246	285	183	379	190	224	121	152	146	448	16871
16	276	198	23	53	423	114	4947	840	128	140	97	96	110	36	342	752	868	442	456	637	146	171	226	50	1190	272	235	273	156	344	170	189	118	148	140	444	15048
17	306	213	39	58	468	129	4437	860	130	142	99	94	112	36	327	702	633	420	457	617	133	173	213	44	1214	281	243	281	130	334	165	184	122	153	145	483	14577
18	390	255	60	76	585	168	4726	1300	142	156	107	118	124	42	384	679	658	404	498	650	139	191	223	43	1351	310	268	311	136	355	171	192	134	165	161	544	16216
19	468	300	75	124	711	204	4862	1640	166	181	127	160	142	50	528	700	749	432	586	714	154	220	247	46	1552	362	312	362	155	397	181	213	153	186	187	631	18277
20	534	342	88	178	819	237	5525	2020	198	215	154	200	166	62	711	797	895	494	708	806	183	260	278	50	1803	427	387	427	187	462	207	241	178	212	221	718	21370
21	612	387	101	212	927	270	5916	2490	232	251	182	244	192	74	912	864	1074	544	852	946	212	307	318	58	2094	500	430	500	218	530	234	281	206	242	259	810	24481
22	690	438	113	225	1053	306	6885	2950	266	288	211	290	220	86	1116	1000	1250	626	993	1075	242	347	360	66	2380	571	490	571	248	611	262	331	233	270	295	893	28251
23	762	483	123	236	1143	333	7497	3340	297	320	236	328	230	96	1314	1090	1417	688	1124	1197	274	388	396	74	2636	637	546	637	289	669	285	374	257	296	327	953	31292
24	828	522	133	245	1242	360	8262	3860	322	345	257	366	246	104	1467	1187	1545	750	1225	1323	309	426	429	84	2930	686	588	686	329	735	313	408	274	313	351	1002	34452

FEBRUARY

DAY	BUILDING TYPE																																			
HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	702	438	116	222	1098	324	7633	3560	260	281	206	314	214	82	1188	1064	1275	660	990	1148	282	364	360	76	2371	548	475	548	311	637	267	368	217	259	284	869	30011
2	750	468	123	230	1170	345	8075	3780	281	302	224	336	230	90	1305	1150	1393	710	1079	1228	302	396	388	81	2532	594	514	594	334	692	290	394	234	276	306	910	32106
3	798	498	131	237	1251	366	8755	4130	301	322	241	368	246	96	1422	1237	1506	760	1163	1338	333	422	414	87	2715	637	550	637	358	737	309	434	250	293	326	951	34619
4	834	519	135	242	1305	384	9010	4300	316	338	254	384	256	102	1512	1311	1598	804	1230	1398	347	441	434	91	2835	671	577	671	380	770	322	454	262	305	342	986	36120
5	876	543	143	257	1377	405	9707	4630	328	351	267	414	268	106	1590	1391	1679	852	1285	1475	368	469	445	99	2953	698	600	698	396	819	339	476	272	315	354	1016	38261
6	894	555	144	261	1413	417	10132	4790	335	359	273	428	274	108	1659	1453	1735	886	1321	1522	390	482	453	103	3023	713	613	713	400	841	353	480	278	320	361	1038	39520
7	912	564	145	264	1467	435	10489	5070	339	362	277	434	276	108	1710	1524	1776	914	1341	1578	406	495	457	108	3078	720	619	720	408	864	363	485	280	322	364	1052	40726
8	906	558	145	263	1467	435	10744	5120	335	358	275	438	274	106	1707	1569	1777	926	1329	1588	414	490	454	110	3057	709	609	709	417	869	364	490	276	316	357	1050	41011
9	810	510	142	258	1404	414	10659	4730	321	343	262	402	262	100	1647	1565	1727	918	1276	1532	398	473	444	110	2872	677	582	677	424	839	344	490	262	301	339	1027	39541
10	714	459	110	236	1269	375	10217	4290	297	318	241	370	246	92	1524	1530	1623	896	1184	1484	383	444	425	108	2667	627	539	627	425	800	328	486	241	280	313	983	37151
11	612	405	85	225	1125	330	9826	3790	268	287	215	324	224	82	1341	1474	1479	858	1065	1395	365	405	401	104	2422	565	487	565	423	751	307	476	215	256	280	926	34358
12	522	357	66	212	981	285	9299	3270	238	254	187	276	200	72	1128	1382	1311	806	930	1279	324	356	373	97	2157	496	429	496	414	681	287	460	189	229	246	859	31148
13	432	306	42	200	783	225	8500	2580	208	222	160	220	174	60	921	1220	1134	724	793	1093	280	298	345	86	1867	426	370	426	375	584	257	397	163	203	211	787	27072
14	366	264	29	164	639	180	7531	2140	175	193	135	174	150	50	729	1072	959	628	664	962	240	253	317	77	1648	359	314	359	256	506	233	296	139	178	178	592	23149
15	306	228	20	96	531	150	6783	1640	151	167	115	132	132	42	576	915	816	542	566	825	203	213	295	65	1430	308	272	308	206	439	203	246	122	160	154	508	19865
16	300	219	24	65	477	132	6120	1480	134	147	104	108	120	36	456	801	704	474	496	736	181	198	246	56	1296	274	244	274	171	399	186	226	111	148	139	482	17764
17	312	219	32	60	495	138	5474	1380	129	140	101	100	114	34	396	708	634	426	463	682	162	184	221	50	1245	262	234	263	159	384	173	203	108	146	134	480	16445
18	354	237	48	64	549	156	5202	1550	130	142	102	106	116	36	381	661	609	394	464	651	158	186	217	44	1270	269	241	269	155	371	161	197	111	150	138	510	16399
19	414	267	67	87	675	195	5219	1810	136	148	106	142	122	40	420	664	620	408	487	684	166	210	224	47	1380	285	255	285	166	398	169	209	117	157	148	571	17498
20	462	291	76	118	738	219	5457	2140	150	164	114	172	132	44	528	700	682	426	540	732	180	230	238	48	1507	314	280	314	185	426	180	228	129	168	164	612	19088
21	504	318	85	153	810	240	5644	2430	168	184	126	196	144	50	651	749	772	456	611	791	202	250	257	51	1665	350	311	351	202	457	193	247	143	182	183	658	20784
22	546	342	92	192	882	258	5967	2700	190	207	146	226	160	58	798	816	888	504	699	888	217	280	283	58	1842	396	350	397	233	506	213	280	160	200	208	719	22901
23	600	375	98	205	954	279	6562	2950	213	231	166	254	178	66	933	893	1011	554	792	971	239	307	305	64	2014	445	390	445	246	540	227	309	179	219	232	769	25215
24	642	402	106	214	1017	297	7021	3180	236	256	186	288	196	74	1062	982	1144	606	892	1059	260	336	334	70	2192	497	433	497	274	588	247	339	198	239	258	827	27449

Table 3B – 1

MARCH

DAY HOUR	BUILDING TYPE																																				
	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	426	273	70	155	387	99	2958	1790	140	153	109	170	128	46	492	441	525	264	523	592	134	211	213	30	1489	280	266	280	9	362	142	171	103	143	150	567	14289
2	486	312	81	192	504	135	3655	2160	163	180	122	204	148	56	684	560	699	324	641	712	158	248	248	39	1689	344	317	344	136	416	165	213	127	166	180	641	17449
3	540	342	89	201	792	228	4267	2490	191	210	141	236	164	64	819	644	835	426	734	797	185	273	276	45	1877	393	357	393	174	471	188	240	146	183	204	699	20314
4	588	375	96	208	873	252	4998	2810	215	234	164	258	178	70	933	748	948	488	811	897	205	303	302	53	2044	432	389	432	198	512	205	276	161	197	222	749	22824
5	618	390	102	212	927	270	5372	2990	230	249	178	274	186	74	1008	849	1031	538	860	964	231	320	319	58	2138	455	406	455	235	554	224	299	169	203	231	775	24394
6	642	405	105	214	999	291	6052	3270	238	257	186	298	188	74	1065	912	1086	576	887	1022	247	334	334	65	2200	466	413	466	258	578	235	331	173	204	235	801	26107
7	642	402	107	213	1017	300	6324	3380	237	256	187	300	188	72	1083	977	1098	608	878	1047	256	339	335	68	2198	456	402	456	278	585	243	343	168	197	228	789	26657
8	576	363	97	209	981	288	6562	3290	224	243	177	276	176	66	1050	1002	1067	612	833	1019	258	330	325	69	2046	426	375	426	285	577	226	334	155	182	211	735	26071
9	468	306	73	200	882	258	6375	2990	200	217	157	246	160	58	945	993	981	592	746	963	247	305	305	70	1832	376	332	376	272	555	211	329	134	159	184	651	24148
10	342	243	42	183	702	204	6001	2370	168	183	130	200	136	48	774	950	850	550	628	864	227	264	273	64	1559	313	278	313	252	492	184	291	108	133	150	532	21001
11	210	177	13	104	495	138	5270	1660	130	143	98	128	108	36	561	840	684	482	486	721	184	209	235	55	1232	239	215	239	198	407	152	234	77	104	110	410	16784
12	102	117		29	342	93	4607	1110	99	109	77	66	78	22	318	686	489	390	332	542	141	148	190	46	912	158	147	158	135	317	119	164	45	73	68	285	12714
13	72	72		12	270	72	3621	520	77	84	60	16	50	10	93	510	293	294	186	393	95	94	148	35	637	80	83	80	79	225	93	105	17	44	30	180	8730
14	42	24			180	45	2856	70	55	61	43		26			333	109	196	56	214	46	41	107	21	358	11	26	11	20	135	64	39		19		80	5288
15	24	15			99	24	2023		39	43	30		6			182		106		101	21	13	71	11	184					81	37	13				24	3147
16	12	9			45	9	1173		28	31	21		4			52		46		12			43	2	44					37	12						1580
17	18	12			9		561		24	27	18		2					10					25							13							719
18	36	18			18		323		27	30	20		2										21							15						15	525
19	66	30			81	15	170		35	38	26		2										30		161					32						109	795
20	132	42			126	30	408		47	52	36		14					26					48		333					69	10			16		180	1569
21	108	96			171	45	850		63	69	48		32					68				58	76		538		37			121	35			38		248	2701
22	138	150		10	234	60	1207		80	87	62		54	10				108	114	199	20	100	107		759	66	91	66		172	62		15	63	37	322	4393
23	168	189		55	270	69	1598	740	100	109	77		78	24		142	95	160	255	309	73	134	142		985	141	151	141		230	86	27	46	91	77	401	7163
24	312	234	22	110	333	84	2363	1410	120	131	93	90	102	36	195	318	321	214	391	452	100	170	177	20	1243	214	210	214		303	112	135	75	118	115	488	11025

APRIL

DAY HOUR	BUILDING TYPE																																				
	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	42	33			0				69	76	53		32					118													61						484
2	120	150		23					84	92	64		52	2				152							89						5						833
3	240	180		62	117				97	107	74		68	12				16	117				132		962		62									89	2335
4	312	207	43	101	270	33			109	120	84	49	82	20	213		81	184	228			107	163		1124	16	110	16		184				15	21	415	4307
5	354	228	59	130	306	75			118	129	91	73	92	28	378		263	222	316			176	182		1230	77	146	77		295			3	38	50	452	5588
6	378	243	65	150	342	87		1280	124	135	96	81	98	32	474	280	392	244	378			191	200		1307	121	170	121		322	76		23	54	70	470	8004
7	378	243	64	149	360	93		1840	128	142	97	83	102	34	522	511	482	312	419	106	23	198	207		1326	150	185	150		338	128		37	64	82	475	9428
8	306	207	47	120	351	93	2516	1700	125	139	94	75	100	34	498	550	500	344	411	457	134	197	204		1256	152	178	152		344	123		39	63	80	433	12022
9	210	159	20	74	297	75	2737	1310	107	117	83	64	84	26	375	529	426	320	339	411	127	179	184	26	1092	121	144	121		318	107	67	25	48	60	349	10731
10	72	90		19	225	54	2295	680	84	93	65	34	60	16	192	457	280	260	218	335	101	132	149	27	777	63	90	63		258	71	132		22	27	217	7658
11		24		2	126	30	1734	120	58	64	44	3	28	2		323	84	178	62	223	64	74	106	18	435		21			176	35	71				91	4196
12					45	6	952		31	35	23		2			156		82		32	23	21	59	8	112					85		14					1686
13									5	8	2									4			12														29
14															18																						18
15																																					0
16																																					0
17																																					0
18																																					0
19																																					0
20		15																		65					60												140
21		33			45																	19			262												359
22		3							24	32		9						20		49		53			492						15						697
23									53	58	40		10					72		140		5			32						39						449
24																																					

Table 3B – 2

MAY

DAY HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
																		BUILDING TYPE																			
1	30	36																46				8			252												372
2	6	3			36							8						90		9		39			448												639
3									24	40			6					124		111		74			646						25						1050
4		6							61	68			24					24				6			39						48						276
5	48	108		23					71	78	30		36					72													65						531
6	180	144		44					78	85	53		44					142					44		178						5						997
7	186	132		44	54				79	87	59	3	48					136	50				116		767												1761
8	108	90		19	153				74	81	60	24	44					114	58			42	112		657											38	1674
9	18	45		1	90				57	63	56	14	26					70				69	89		488					140						131	1357
10		6							33	37	43							16				30	48		146					80							439
11									4	5	23												4														36
12																																					0
13																																					0
14																																					0
15																																					0
16																																					0
17																																					0
18																																					0
19																																					0
20																																					0
21																																					0
22																																					0
23																																					0
24		15																							15												30

JUNE

DAY HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
																		BUILDING TYPE																			
1																																					0
2																																					0
3																																					0
4																									151												151
5																						12			245												257
6																						24			295												319
7																						12			221												233
8																									53												53
9																																					0
10																																					0
11																																					0
12																																					0
13																																					0
14																																					0
15																																					0
16																																					0
17																																					0
18																																					0
19																																					0
20																																					0
21																																					0
22																																					0
23																																					0
24																																					0

Table 3B - 3

JULY

DAY / HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1																																					0
2																																					0
3																									45												45
4																									133												133
5																									203												203
6																									245												245
7																									167												167
8																																					0
9																																					0
10																																					0
11																																					0
12																																					0
13																																					0
14																																					0
15																																					0
16																																					0
17																																					0
18																																					0
19																																					0
20																																					0
21																																					0
22																																					0
23																																					0
24																																					0

AUGUST

DAY / HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1																																					0
2																																					0
3																																					0
4																									108												108
5																		16							201												217
6																		28		14					272												314
7																		38		38					291												367
8																		22							213												235
9																									23												23
10																																					0
11																																					0
12																																					0
13																																					0
14																																					0
15																																					0
16																																					0
17																																					0
18																																					0
19																																					0
20																																					0
21																																					0
22																																					0
23																																					0
24																																					0

Table 3B - 4

SEPTEMBER

DAY	BUILDING TYPE																																			
HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	24	27																42							143												236
2		3			45													76				21			339												484
3	60								2	15								114		73		47			493						18						822
4	174								46	51	9							22		151		4			30						39						526
5	120	33							55	60	41		14					30													54						407
6	18	99		6					60	66	46		33					110													4						442
7		117		9					63	69	48		39					114					48		342												849
8		87		1	153				58	63	44		33					94					84		528												1145
9		33		1	99				45	50	34		15					84					68		339												768
10					27				24	27	18							24					38														158
11																																					0
12																																					0
13																																					0
14																																					0
15																																					0
16																																					0
17																																					0
18																																					0
19																																					0
20																																					0
21																																					0
22																																					0
23																																					0
24		6																4																			10

OCTOBER

DAY	BUILDING TYPE																																			
HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	378	246	65	141	360	93	2431		132	145	102	64	112	38	354	421	445	250	431	462		179	203		1333	214	212	214		306	124		81	108	114	505	10263
2	438	279	74	182	405	102	3111	310	147	161	114	85	128	46	558	532	612	318	538	602	34	213	230	30	1528	270	256	270		364	149	101	102	128	141	565	13123
3	480	309	79	193	441	114	3519	2110	171	189	124	100	138	52	678	612	744	406	625	699	143	236	257	39	1667	316	292	316		404	165	206	118	144	162	605	16853
4	522	333	87	199	495	129	4165	2320	191	209	143	110	150	58	774	722	849	466	693	780	163	264	276	47	1814	351	319	351		453	186	233	131	156	178	651	18968
5	558	351	92	203	522	138	4794	2610	204	222	156	123	162	60	852	792	928	504	740	861	189	280	293	51	1900	374	336	374	174	482	199	264	139	163	188	686	20964
6	582	363	97	205	657	180	5525	2920	212	230	165	132	168	62	912	869	980	544	676	930	209	302	307	59	1991	387	345	387	234	521	216	290	144	166	193	715	22875
7	576	360	96	203	900	264	5797	3010	208	226	163	131	162	60	912	908	973	562	748	949	218	298	306	62	1944	374	333	374	254	524	218	300	138	158	185	695	23589
8	498	315	85	196	846	249	5695	2860	190	206	149	118	148	52	837	922	901	560	675	895	216	282	289	63	1751	331	294	331	245	493	199	296	120	137	161	631	22236
9	366	243	59	166	720	210	5338	2340	158	171	122	94	122	42	684	893	762	526	548	810	195	238	256	60	1463	260	233	260	224	437	173	268	90	106	123	512	19272
10	222	165	26	82	495	144	4556	1560	116	126	87	68	90	28	447	800	573	464	385	682	169	186	213	53	1093	174	159	174	197	366	141	221	55	70	78	380	14845
11	78	87		20	315	87	3757	790	81	88	64	29	56	12	174	677	360	380	208	498	115	119	166	44	706	82	80	82	133	258	102	152	19	33	30	230	10112
12	30	18		3	225	63	2686		54	58	42		22			513	144	282	35	291	57	51	116	31	345		5		66	145	68	77				84	5511
13		3			135	39	1700		30	33	23		6			335		180		114	12		72	17	41				11	54	37	15					2857
14					54	15	799		14	15	10		4		15	147		80		29			34	6							15						1237
15									7	8	4		2			12		10					8														51
16									7	8	5		2																								22
17									12	13	8																										33
18		6							21	24	15																										66
19	42	51							33	36	25												14														201
20	114	90			99	3			48	53	36	4	8										44														499
21	96	51			162	39			65	71	49		28					70					74		281									14		175	1175
22	126	63		9	207	51			82	90	63		50	6				114	38				106		719	17	52	17			20		3	40	9	303	2185
23	150	156		55	252	60			100	109	77		72	18			16	158	181			44	140		927	92	110	92		191	76		32	66	49	368	3591
24	264	213	21	105	297	75	255		117	128	90		92	28	84	301	253	204	313	287		150	171		1150	161	165	161		255	103		59	90	84	438	6114

Table 3B - 5

NOVEMBER

BUILDING TYPE

DAY HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9
1	402	258	68	150	387	99	3145	1130	136	148	105	80	120	44	432
2	468	300	78	193	450	117	3859	1930	159	176	119	92	142	54	624
3	522	333	87	202	756	216	4556	2270	188	206	139	108	158	60	765
4	564	360	94	209	828	237	4981	2610	213	232	163	123	172	68	888
5	618	387	100	214	891	255	5593	2800	230	250	179	132	178	72	981
6	642	405	105	217	963	279	6205	3090	243	263	191	144	188	74	1056
7	660	414	108	219	999	291	6545	3360	249	269	196	152	194	76	1104
8	648	405	108	216	1026	300	6987	3410	244	263	193	149	192	72	1095
9	540	345	89	208	918	267	6630	3030	220	238	174	129	174	64	987
10	396	267	58	194	738	213	5984	2310	184	199	144	103	146	50	786
11	276	198	29	113	549	156	5219	1590	139	151	106	73	110	34	510
12	156	129	3	26	387	111	4165	820	97	106	77	40	72	18	222
13	102	69		9	297	84	3179	200	67	73	53	14	36	2	
14	60	30			207	60	2091		42	46	34		8		
15	36	18			117	36	1088		25	27	20		6		
16	30	15			72	21	153		18	20	14		4		
17	36	18			63	18			19	20	14		2		
18	54	27			117	33			25	28	20		2		
19	96	33			144	39	306		36	39	28		2		
20	90	42			180	51	697		48	52	37		14		
21	108	78		6	198	51	1071		63	69	49		32		
22	138	144	29	17	252	66	1513		80	88	62		54	10	
23	168	183	48	56	279	72	1921		98	108	76		76	22	
24	348	222	58	109	333	87	2550		118	128	91	53	98	34	153

DAY HOUR	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	535	642	350	505	567	109	191	213	32	1412	268	243	269	64	327	140	161	112	133	141	529	13647
2	632	789	414	621	682	140	228	246	38	1609	331	294	331	134	390	166	200	134	156	171	603	17070
3	722	913	466	719	772	161	262	274	46	1806	382	336	382	172	438	186	229	152	174	195	664	20017
4	818	1024	516	804	872	190	292	301	53	1984	426	373	426	193	491	208	265	167	190	216	720	22271
5	893	1109	564	868	962	207	312	321	59	2101	457	399	457	230	538	223	289	178	201	230	754	24232
6	963	1172	604	912	1023	233	328	339	65	2190	478	415	478	251	567	235	320	184	207	239	789	26057
7	1033	1209	640	932	1068	247	347	348	69	2268	485	421	485	284	587	249	338	186	208	241	807	27288
8	1074	1191	658	906	1089	255	340	348	72	2203	468	406	468	298	602	250	347	178	198	231	790	27680
9	1076	1092	650	814	1018	243	313	326	72	1954	412	358	412	276	554	227	330	155	173	201	704	25373
10	1021	929	602	670	929	218	264	292	69	1632	331	290	331	251	491	204	288	122	138	159	577	21580
11	928	702	538	481	770	182	203	245	60	1285	230	204	230	208	402	174	238	82	96	107	438	17054
12	781	457	444	280	586	133	140	197	51	892	126	116	126	156	296	140	176	42	54	54	297	11973
13	612	218	344	88	401	78	75	140	40	550	27	32	27	102	184	105	114	6	15	5	170	7518
14	428	24	236		222	32	21	92	25	214				35	92	68	42				66	4175
15	276		152		63			55	13						13	36						1981
16	154		88		22			32	4							19						666
17	114		60		9			24								9						406
18	80		50					30								16					37	519
19	101		62		3			41								23					127	1080
20	148		96		10			62	3	359					40	37			6		185	2157
21	199		132		187		5	89	8	527		14			110	53		10	30		243	3332
22	265	125	178	115	283		91	117	14	738	65	74	65		166	75		37	57	38	320	5276
23	351	307	234	249	374	7	128	148	20	972	137	132	137		218	96	99	64	83	75	380	7318
24	450	482	292	382	478	88	162	182	26	1185	208	191	208		276	119	133	90	109	110	458	10011

DECEMBER

BUILDING TYPE

DAY HOUR	1A	1B	1C	2	3A	3B	4A	4B	5A	5B	5C	6	7	8	9
1	600	378	98	211	909	264	5865	2680	227	246	178	130	182	70	951
2	654	408	106	217	981	285	6545	3030	246	266	194	145	196	76	1059
3	684	429	112	223	1044	303	7072	3350	261	282	208	154	206	82	1149
4	714	447	116	227	1098	321	7463	3520	273	295	218	162	214	84	1230
5	738	459	122	229	1143	333	8041	3820	281	302	225	170	220	86	1287
6	756	468	123	230	1269	348	8398	3950	285	305	228	176	224	88	1323
7	762	468	127	228	1215	360	8755	4110	281	300	226	182	222	84	1326
8	738	453	123	223	1197	357	8789	4180	267	285	215	180	208	80	1275
9	636	396	109	214	1107	330	8449	3740	242	259	194	157	188	70	1167
10	510	324	82	202	945	282	7769	3060	207	224	166	131	164	58	1005
11	384	255	54	184	747	219	1717	2290	170	186	134	102	136	46	780
12	270	192	26	97	558	159	5814	1460	135	146	105	73	108	34	528
13	198	150	9	31	432	123	4777	820	105	115	82	50	86	24	312
14	162	117		23	360	102	3995	270	91	98	72	27	68	16	156
15	156	105		20	306	84	3196	50	85	93	67	12	62	14	63
16	156	108		20	270	75	2465		85	92	66	3	62	14	18
17	174	132	22	22	288	75	2448		89	97	69	8	66	16	
18	204	168	40	25	333	90	2516	140	96	105	75	26	74	20	
19	306	198	53	35	369	102	2635	670	106	116	83	41	84	26	108
20	354	225	60	75	405	111	3247	1100	118	129	93	58	100	34	264
21	402	255	69	114	549	156	3689	1400	133	147	102	73	114	42	414
22	444	285	76	155	675	195	4131	1690	159	174	116	88	132	50	558
23	498	315	84	193	756	219	4777	2080	183	199	139	102	148	56	693
24	552	348	91	204	828	240	5372	2430	205	222	158	118	166	64	819

DAY HOUR	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTAL
1	901	1079	568	834	958	211	306	316	62	2047	457	393	457	231	532	228	299	184	207	233	768	24260
2	986	1183	616	911	1041	241	330	338	67	2020	496	426	496	266	574	246	326	198	221	251	820	26461
3	1061	1273	660	976	1122	257	356	357	72	2337	527	453	527	288	608	259	348	209	233	266	852	28600
4	1120	1348	694	1030	1183	283	374	376	76	2437	552	474	552	309	649	277	378	218	242	278	886	30118
5	1184	1397	728	1062	1233	297	388	388	82	2506	566	485	566	330	673	287	397	222	246	284	898	31675
6	1243	1428	758	1078	1280	311	399	396	86	2552	572	489	572	364	693	296	415	224	248	286	903	32764
7	1292	1424	782	1062	1318	325	406	395	90	2556	560	478	560	384	705	302	432	218	241	279	895	33350
8	1299	1369	780	1004	1298	333	395	380	92	2458	524	447	524	387	697	294	428	203	225	259	867	32833
9	1276	1263	754	904	1220	310	360	356	89	2203	465	397	465	366	646	276	410	180	199	229	817	30443
10	1214	1117	712	775	1114	286	312	326	86	1886	392	336	393	339	585	247	368	151	169	192	719	26848
11	1137	945	656	629	975	247	260	294	78	1550	315	271	315	295	502	219	317	121	139	153	554	17376
12	997	765	572	484	806	198	204	260	68	1247	242	209	242	240	409	188	255	93	112	116	432	17844
13	874	601	502	358	654	147	151	215	59	1004	182	158	182	188	318	163	202	72	91	87	335	13857
14	720	473	416	267	511	107	110	180	47	803	141	123	141	133	249	142	148	60	78	68	274	10748
15	613	396	352	224	420	81	95	159	38	700	127	111	127	93	212	122	114	57	76	63	252	8745
16	525	350	312	210	355	54	76	145	29	654	129	113	129	52	181	108	80	61	80	66	257	7400
17	469	325	276	216	348	46	86	145	26	718	140	124	140	49	190	101	81	66	87	72	304	7515
18	455	327	274	239	378	57	106	149	26	872	159	141	159	61	212	108	95	74	95	82	363	8344
19	474	377	292	290	425	72	128	164	26	1012	189	166	189	66	232	119	114	85	105	98	419	9974
20	519	474	324	370	493	97	158	187	32	1162	229	200	229	97	281	132	137	100	120	119	474	12307
21	585	586	372	457	578	110	187	208	35	1334	271	236	271	113	328	151	167	116	136	141	527	14568
22	644	713	410	554	677	145	218	236	42	1516	319	277	319	142	380	166	201	133	154	165	591	16930
23	736	839	462	652	767	168	246	262	48	1693	367	317	367	181	429	191	231	151	172	188	647	19556
24	812	959	318	743	847	188	272	287	53	1883	412	355	412	205	473	209	258	167	190	211	704	21775

Table 3B - 6

TONNAGE PROFILE BY MONTH - BUILDINGS SERVICED BY NORTH CENTRAL UTILITY PLANT - BUILDING 25910

DAY HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	36795	30011	14289	484	372	0	0	0	236	10263	13647	24260
2	38316	32106	17449	833	639	0	0	0	484	13123	17070	26461
3	39235	34619	20314	2335	1050	0	45	0	822	16853	20017	28600
4	39768	36120	22824	4307	276	151	133	108	526	18968	22271	30118
5	40055	38261	24394	5588	531	257	203	217	407	20964	24232	31675
6	39771	39520	26107	8004	997	319	245	314	442	22875	26057	32764
7	39082	40726	26657	9428	1761	233	167	367	849	23589	27288	33350
8	38253	41011	26071	12022	1674	53	0	235	1145	22236	27680	32833
9	35813	39541	24148	10731	1357	0	0	23	768	19272	25373	30443
10	32675	37151	21001	7658	439	0	0	0	158	14845	21580	26848
11	29203	34358	16784	4196	36	0	0	0	0	10112	17054	17376
12	26212	31148	12714	1686	0	0	0	0	0	5511	11973	17844
13	22683	27072	8730	29	0	0	0	0	0	2857	7518	13857
14	19278	23149	5288	18	0	0	0	0	0	1237	4175	10748
15	16871	19865	3147	0	0	0	0	0	0	51	1981	8745
16	15048	17764	1580	0	0	0	0	0	0	22	666	7400
17	14577	16445	719	0	0	0	0	0	0	33	406	7515
18	16216	16399	525	0	0	0	0	0	0	66	519	8344
19	18277	17498	795	0	0	0	0	0	0	201	1080	9974
20	21370	19088	1569	0	0	0	0	0	0	499	2157	12307
21	24481	20784	2701	140	0	0	0	0	0	1175	3332	14568
22	28251	22901	4393	359	0	0	0	0	0	2185	5276	16930
23	31292	25215	7163	697	0	0	0	0	0	3591	7318	19556
24	34452	27449	11025	449	30	0	0	0	10	6114	10011	21775

Table 3C

ROWLAND
01!Fort Gordon
P1CARLTON SHUFORD
P2DSN 780-6376
P3ATZH-DIC-E
/RECALL F 000045555 S 03 ECIP PROJECT 3: UPGRADE BOILER PLANT BUILDING 25910, FT. GORDON

03A !DESCRIPTION OF PROPOSED CONSTRUCTION

***The concept of the heating plant as a steam generating boiler plant which sparges steam into the high temperature water, and is then pumped through the underground pipe distribution has changed completely. The new concept is to replace the steam boilers with hot water generators operating in an auxiliary loop circulating HTW water system from and to the three existing cascade heaters that will be converted for use as expansion/storage tanks. Those tanks will now be pressurized with nitrogen and the pressure on the tank will vary as the water level increases or decreases. The water level will change based on the variable speed pumping and losses in the system. The existing deaerator needs to be modified before any other work is done. The deaerator vessel and storage tank are hopefully reusable, but is our suspicion that the trays within the deaerator are not operating or need to be replace entirely. Another item that needs to be done prior to making the switch over from steam to hot water is to add chemical feed tanks and have chemicals feed at the appropriate locations. This should be done in coordination with the chemical supplier, but basically we are adding sulfite and PH control to the make-up water in the deaerator or immediately after the deaerator. Then there is an additional chemical that needs to be added to the distribution system to make sure that the oxygen corrosion is not an additional problem, and that exposed piping does not corrode. The distribution piping shall also be protected from oxygen pitting and PH imbalance when the make-up water requirement is reduced.

Because there is a multiplicity of units available to be converted and to be replaced with new, it is possible that the steam can remain in operation while the new hot water generators are added and one or more of the cascade heaters is converted so that the plant can serve the needs of the distribution system during the construction period. Then there will be a small shutdown period where you convert over to hot water generation from steam generation. If this can be coordinated with the summer shutdown so that all of the work in the buildings is completed to generate domestic water, then the HTW system can be shutdown 4-1/2 months of the summer to make this conversion from steam to hot water generation.

03B !REMARKS

***Data for this analysis was based on assumed existing efficiency of the boilers of 70%. This was in lieu of not having any accurate information on the efficiencies of the boilers. Recent articles in the ASHRAE Journal and elsewhere indicates that for the Plant as it is now, 70% is probably a very high efficiency for the actual conditions. Even with this payback indicated, we can expect a better payback if the projects are implemented. There are also opportunities to increase the savings if higher efficiency equipment is installed in the buildings. We assumed 80% efficiency for gas combustion, but there are gas-fired heaters that can get into the 90's. This costs additional money, but they may be worthwhile on the basis of dollars they save when the current natural gas prices are compared with high efficiency water heating equipment prices.

The energy conservation measure to upgrade the Heating Plant in Building 25910 includes seven ECO's developed during the extensive engineering study that was conducted. The following describes the ECO's that are included in this ECIP.

ECO NO.	DESCRIPTION
25	Variable Speed Hot Water Pumping
27	Return Hot Water Temperature Control
31	Reduce Make-Up Water-Hot Water
67	Hot Water Generators
69	Summer Shut Down (1/2 Gas, 1/2 Heat Pumps)
71	Reduce Steam Leaks
88	EMCS Controls & Instrumentation

ECO DATA COMPILATION

ECO NO.	DESCRIPTION	COST (FROM LCC)	SAVINGS 1ST YEAR	TOTAL DISCOUNT SAVINGS
25	Variable Speed Hot Water Pumping	179,986	15,962	245,689
27	Return Hot Water Temperature Control	70,597	19,181	339,832
31	Reduce Make-Up Water-Hot Water	61,451	26,829	551,858
67	Hot Water Generators	1,499,570	97,887	1,946,822
69	Summer Shut Down (1/2 Gas, 1/2 Heat Pumps)	488,696	172,367	3,034,235
71	Reduce Steam Leaks	2,056	1,793	37,594
88	EMCS Controls & Instrumentation	74,163	21,244	445,267
	Totals	2,336,519	355,263	6,601,297

03C !PROJECT DESCRIPTION

***This Energy conservation measure provides the plan to design the required conservation and upgrade to the heating system in building 25910 - Central Utility Plant - North. The scope of this effort includes addition of two new variable speed pumps, additional control for hot water return temperature regulation, reduction of make-up water required and replacement of five low efficiency steam boilers with three hot water generators. In addition the piping distribution system will be redesigned into three distribution systems and hot water/steam leaks will be reduced or eliminated.

To maximize energy savings, new EMCS controls will be added to permit control of the HTW system from the Energy Management Control System. This system will permit optimization of how water temperature set point, time of day scheduling and summer shut down of the system. This function will support minimizing staffing requirements.

03D !REQUIREMENT (Why is it needed now)

****The existing steam heating plant is antequated and inefficient. The study showed that the boilers are

operating at about 70% efficiency, large quantities of make-up water is required to overcome leaks in the existing system. Recent building renovations to the hot water systems in the Barracks, classrooms and administrative office have increased demand for heating capacity.

By implementing the energy conservation improvement now, annual savings of $354,008 can be realized, reducing the cost of operation for the entire facility.

03E !CURRENT SITUATION (How is the need currently being met)

***ECO 25

There are three zones leaving Plant 25910. Each has a set of identical pumps serving each zone. Zones 1 and 3 have 50 hp motors rated at 3550 rpm. Zone 2 has the same pump with a 75 hp motor rated at 3550 rpm. The pumps usually operate on the low speed which is 1750 rpm, and the horsepower is 1/4 of that given above at the higher speeds. Pumps in Zone 1 are Dean Brothers pumps sizes 3 x 4 x 9-1/4 impeller, Model No. 8434; the Serial No. on one of the pumps is 148840. The pumps in the other zones are similar. Just upstream of the HTW pumps is the blending station which blends return HTW with water leaving the cascade heater to maintain a setpoint temperature at the blending station for HTW supply water. Water levels in the cascade heaters are effected by the setpoints on the HTW blending stations. By decreasing the temperature setting on Zone 3 Blending Station, it was noted that the HTW return water flow increased and then the level of the cascade heater above Zone 3 went up relative to the water levels in the other cascade heaters. Entering each building at the distribution system is a 2-way valve so that when HTW is not required in the building on the distribution system, the flow ceases to that building.

ECO 27

HTW is heated in cascade heaters, which is usually maintained at the temperature of the saturation pressure of the boiler, and this boiler pressure is usually maintained except for several times a year when it is changed. At 150 psi, the saturation temperature is 347°F. When the HTW water leaves the cascade heaters, it passes through a blender that adds unheated HTW return to control the setpoint that maintains the constant HTW supply temperature. Note that as distribution loads vary; less or more HTW water is required, and the HTW return temperature rises and falls depending upon the load. The existing system operates to control the HTW supply water, and does not take into account changes to load that would effect the overall heating requirements.

ECO 31

The total number of gallons lost in Building 25910 over the course of 1992 is 2,039,102 gallons. This leakage is caused by pipe failures and operating inefficiencies in the system and the quantity of lost water is based on reports of water meter readings made by the boiler plant operators.

ECO 67

There are five boilers in Building 25910 heating and cooling plant which have not been tested for combustion efficiency in the studies conducted several years ago because of reported asbestos. These boilers are firing with natural gas and No. 2 oil, but they were originally built for coal firing. 70%

combustion efficiency is assumed for this report, but it would not be surprising if , upon conducting tests, this efficiency was found to be lower than 70%. The furnace area is spacious with less heat absorbing tubes than would be in a boiler designed for natural gas firing. The rear section of the boiler is under negative pressure from the high stack and ID fans so air leakage into the boiler is expected. From the recorded temperatures leaving the boilers it is reasonable to believe that air leakage is reducing the expected flue gas temperature by 70-100°F. Only three of the five boilers are currently operable in 1994.

ECO 69

Space heating is not required from mid-May through the end of September, but a boiler must be in operation to handle domestic water needs and cooking requirements in some cases with the HTW distribution system.

ECO 71

There are steam leaks in some valves and in holes drilled in the cascade heaters. The total steam leakage is approximated at 50 lbs per hour, which is the equivalent of a half-inch hole at 14,000 ft. per minute steam flow.

ECO 88

Existing plant controls are automatic or manual within the plant only with no EMCS tie-in for control. EMCS office which is manned 24 hours a day has very few, if any instrumentation readouts from the plant, and no controllability of the Plant with the EMCS. Because EMCS personnel are aware of what is happening in many buildings, they are also aware of what is happening on the high temperature water system pertaining to conditions and demands. Currently, the boiler operators are making boiler pressure changes, HTW changes, bringing on and off boilers, and many manual valving operations. However, they are not performing the functions that an EMCS office can to reduce the energy consumed and to improve the operating efficiency of the plant.

03F !IMPACT IF NOT PROVIDED

***If this project is not implemented, Fort Gordon will continue to waste excessive quantities of energy. Use of antiquated, inefficient and potentially hazardous boilers will continue to require full staffing of boiler rooms and preclude the possibility of reducing energy waste and reducing staffing requirements. The lack of instrumentation on the current system assures energy waste and ultimately high maintenance costs due to inefficient use of the boiler system.

Annual discounted savings has been determined to be $6,574,981 with a simple payback of 6.6 years with a savings to investment (SIR) of 2.81.

heating loads will be unevenly distributed and buildings currently not being provided adequately heating will continue to be cold in the winter.

03G !ADDITIONAL

***New construction and renovation projects on the base will increase demand on the boiler plant to respond to new loading conditions.

03I !RELATED PROJECTS

***ECIP - 45553 - Chilled Water System - Building 25910

ECIP - 45554 - Chilled Water System to Central Utility Plant - Building 25330 South Side

ECIP - 45556 - High Temperature Water System South Plant - Building 25330
/*

07A !GENERAL JUSTIFICATION DATA

***This ECIP project is required to support the army wide effort to reduce energy waste. The project will provide new efficient high temperature hot water boilers and variable speed pumps to reduce energy consumption and increase efficiency. New instrumentation will permit better control and provide a means to reduce staffing requirements.

This ECIP consists of seven ECO's identified during an energy study that constitute a cost justifiable solution to deficiencies in the current operation. The following justification overview lists the ECO's along with their economic justification.

PROJECT NO. 1 - BOILER/HOT WATER SYSTEM NORTH

ECO DATA COLLECTION

ECO NO.	DESCRIPTION	CONSTRUCTION COST	ANNUAL RECURRING COST	NON-RECURRING COST (-) SAVINGS (+)	COST (From LCC)	ELECTRICAL SAVINGS MMBTU/YR	NAT GAS SAVINGS MMBTU/YR	SAVINGS 1stYEAR	TOTAL DISCOUNT SAVINGS
25	Variable Speed Hot Water Pumping	161,421.12	4,000	0	179,986	785.13	0	15,962	245,689
27	Return Hot Water Temperature Control	63,315.00	10,000	0	70,597	0	2,040.00	19,181	339,832
31	Reduce Make-Up Water-Hot Water	55,112.40	1,684	0	61,451	0	5,587.70	26,829	551,858
67	Hot Water Generators	1,344,905.10	15,000	5 Items from LCCD on ECO 67	1,499,570	0	15,736.03	97,887	1,946,822
69C	Summer Shut Down (1/2 Gas, 1/2 Heat Pumps)	402,417.70	79,795	0	448,696	995.23	17,161.56	172,367	3,034,235
71	Reduce Steam Leaks	1,842.75	0	0	2,056	0	398.58	1,793	37,594
88	EMCS Controls & Instrumentation	66,512.88	0	0	74,163	0	4,720.81	21,244	445,267
	Totals	2,095,527	110,659	Same as ECO 67	2,336,519	1780.36	45,644.88	355,263	6,601,297

Simple Payback: $\frac{2,336,519}{355,263} = 6.58$ years

SIR: $\frac{6,601,297}{2,336,519} = 2.83$

07B !TRAFFIC ANALYSIS
***There will be no changes to pedestrian or vehicular traffic as a result of implementing this ECIP.
/*

08B !PRESENT ACCOMMODATIONS AND DISPOSITION
***The physical plant building 25910 housing the boiler plant is adequate to accommodate the new boilers and other modifications once the old boilers are removed. Five Steam boilers are being replaced with three high temperature hot water boilers.
/*

09D !RPMA DISCUSSION
***This ECIP will reduce the amount of Real Property Maintenance Activity because the number of boilers will be reduced, the equipment will be new and deficiencies in the existing miscellaneous equipment such as pipes, valves, strainers, heat exchangers, deaerator vessels and expansion tanks will be replaced or refurbished to provide optimal efficiency. The new equipment will be easier to operate requiring less manual operation and attendance.
/*

10A !ANALYSIS OF DEFICIENCIES
***1) The HW pumps are constant volume pumps and run continuously to supply hot water to the north side of the base. This causes excess power to be consumed even during periods of reduced demand. It is more efficient to have a variable speed pumping capability to off load the pumps, reducing their flow and energy consumption during moderate temperature conditions.
2) Boiler temperature settings are currently set at a constant value regardless of the load requirements. The new system will regulate supply temperature necessary to meet the load requirements. Current control methods set and keep the temperature constant regardless of the requirements, thus wasting energy by overgenerating HTHW.
3) Five old coal fired boilers, converted to using No. 2 oil or natural gas are currently in use. The boilers are inefficient because of the heat chamber is designed for goal firing and have fewer tubes than boilers designed for oil or natural gas. Air leakage into the boiler has reduced the stack temperatures by 70 to 100 F, resulting in inefficient transfer of heat. Only three of the five boilers is currently operational.
4) Existing plant controls are not connected to the energy management control system (EMCS) that is controlling many of the existing facilities. The controls require constant supervision by maintenance personnel. The controls are antiquated and the calibration is questionable, thus creating the conditions for energy waste.
/*

11D !DECISION ANALYSIS
***The following is a detailed breakdown of each of the ECO's. Refer to the table in 7A General Justification Data which summarizes these costs.

ECO 25 - LCCA

1.	Investment		
	A. Construction Cost	$	161,421.00
	B. SIOH	$	8,879.00
	C. Design Cost	$	9,686.00
	D. Total Cost (1A + 1B + 1C)	$	179,986.00
2.	Energy Savings	$	-5,209.00
3.	Non Energy Savings	$	58,960.00
4.	First Year Dollar Savings	$	15,962.00
5.	Simple Payback Period	$	11.28 Years
6.	Total Net Discounted Savings	$	245,689.00
7.	Savings to Investment Ratio	$	1.37

ECO 27 - LCCA

1.	Investment		
	A. Construction Cost	$	63,315.00
	B. SIOH	$	3,483.00
	C. Design Cost	$	3,799.00
	D. Total Cost (1A + 1B + 1C)	$	70,597.00
2.	Energy Savings	$	-3,954.00
3.	Non Energy Savings	$	147,400.00
4.	First Year Dollar Savings	$	19,181.00
5.	Simple Payback Period	$	3.68 Years
6.	Total Net Discounted Savings	$	339,832.00
7.	Savings to Investment Ratio	$	4.81

ECO 31 - LCCA

1.	Investment		
	A. Construction Cost	$	55,112.00
	B. SIOH	$	3,032.00
	C. Design Cost	$	3,307.00
	D. Total Cost (1A + 1B + 1C)	$	61,451.00
2.	Energy Savings	$	-406.00
3.	Non Energy Savings	$	24,827.00
4.	First Year Dollar Savings	$	26,829.00
5.	Simple Payback Period	$	2.29 Years
6.	Total Net Discounted Savings	$	551,858.00
7.	Savings to Investment Ratio	$	8.98

ECO 67 - LCCA

1.	Investment	
	A. Construction Cost	$ 1,344,905.00
	B. SIOH	$ 73,970.00
	C. Design Cost	$ 80,695.00
	D. Total Cost (1A + 1B + 1C)	$ 1,499,570.00
2.	Energy Savings	$ 9,742.00
3.	Non Energy Savings	$ 462,600.00
4.	First Year Dollar Savings	$ 97,887.00
5.	Simple Payback Period	$ 15.32 Years
6.	Total Net Discounted Savings	$ 1,946,822.00
7.	Savings to Investment Ratio	$ 1.30

ECO 69A - LCCA

1.	Investment	
	A. Construction Cost	$ 514,609.00
	B. SIOH	$ 15,730.00
	C. Design Cost	$ 17,160.00
	D. Total Cost (1A + 1B + 1C)	$ 547,499.00
2.	Energy Savings	$ 13,158.00
3.	Non Energy Savings	$ 1,178,832.00
4.	First Year Dollar Savings	$ 187,530.00
5.	Simple Payback Period	$ 2.92 Years
6.	Total Net Discounted Savings	$ 3,270,933.00
7.	Savings to Investment Ratio	$ 5.97

ECO 69B - LCCA

1.	Investment	
	A. Construction Cost	$ 290,266.00
	B. SIOH	$ 15,965.00
	C. Design Cost	$ 17,416.00
	D. Total Cost (1A + 1B + 1C)	$ 323,647.00
2.	Energy Savings	$ 11,168.00
3.	Non Energy Savings	$ 1,178,832.00
4.	First Year Dollar Savings	$ 157,203.00
5.	Simple Payback Period	$ 2.06 Years
6.	Total Net Discounted Savings	$ 2,797,538.00
7.	Savings to Investment Ratio	$ 8.64

ECO 69C - LCCA

1.	Investment		
	A. Construction Cost	$	402,418.00
	B. SIOH	$	22,133.00
	C. Design Cost	$	24,145.00
	D. Total Cost (1A + 1B + 1C)	$	448,696.00
2.	Energy Savings	$	12,163.00
3.	Non Energy Savings	$	1,178,832.00
4.	First Year Dollar Savings	$	172,367.00
5.	Simple Payback Period	$	2.60 Years
6.	Total Net Discounted Savings	$	3,034,235.00
7.	Savings to Investment Ratio	$	6.76

ECO 71 - LCCA

1.	Investment		
	A. Construction Cost	$	1,843.00
	B. SIOH	$	102.00
	C. Design Cost	$	111.00
	D. Total Cost (1A + 1B + 1C)	$	2,056.00
2.	Energy Savings	$	-5,874.00
3.	Non Energy Savings	$	0.00
4.	First Year Dollar Savings	$	538.00
5.	Simple Payback Period	$	3.82 Years
6.	Total Net Discounted Savings	$	11,278.00
7.	Savings to Investment Ratio	$	5.49

ECO 88 - LCCA

1.	Investment		
	A. Construction Cost	$	66,513.00
	B. SIOH	$	3,659.00
	C. Design Cost	$	3,991.00
	D. Total Cost (1A + 1B + 1C)	$	74,163.00
2.	Energy Savings	$	-1,273.00
3.	Non Energy Savings	$	0.00
4.	First Year Dollar Savings	$	21,244.00
5.	Simple Payback Period	$	3.49 Years
6.	Total Net Discounted Savings	$	445,267.00
7.	Savings to Investment Ratio	$	6.00

11E !ECONOMIC ANALYSIS
***ECO 25

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Electrical Work	1	LS	4,000	4,000	6,000	6,000	$10,000.00
Piping	1	LS	20,000	20,000	25,000	25,000	$45,000.00
Demolition	1	LS			15,000	15,000	$15,000.00
New Pumps	2	EA	12,500	25,000	3,000	6,000	$31,000.00
Variable Speed Drive	1	LS	8,500	8,500	1,000	1,000	$9,500.00
Switches	1	LS	4,340	4,340	1,000	1,000	$5,340.00
					SUBTOTAL		$128,112.00
					20% OH (GC ONLY)		$25,622.40
					SUBTOTAL GC'S WORK		$153,734.40
					SUBTOTAL (GC & SUBS)		$153,734.40
					5% CONTINGENCY		$7,686.72
					TOTAL		$161,421.12

ECO 27

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Controls	1	LS	20,000	20,000	15,000	15,000	$35,000.00
Demolition of Control Equip.	1	LS				10,000	$10,000.00
					SUBTOTAL		$50,250.00
					20% OH (GC ONLY)		$10,050.00
					SUBTOTAL GC'S WORK		$60,300.00
					SUBTOTAL (GC & SUBS)		$60,300.00
					5% CONTINGENCY		$3,015.00
					TOTAL		$63,315.00

ECO 31

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Flow Meters	12	EA	1,500	18,000	1,000	12,000	$30,000.00
Temp ROD In Distribution	12	EA	300	3,600	500	6,000	$9,600.00
					SUBTOTAL		$43,740.00
					20% OH (GC ONLY)		$8,748.00
					SUBTOTAL GC'S WORK		$52,488.00
					SUBTOTAL (GC & SUBS)		$52,488.00
					5% CONTINGENCY		$2,624.40
					TOTAL		$55,112.40

ECO 67

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Hot Water Generator	3	EA	250,000	750,000	Lump Sum	100,000	$850,000.00
Repiping of Cascade Heater	3	Ton	3,000	9,000	4,000	12,000	$21,000.00
Piping For 1 Zone From 3 Zone	1	LS	20,000	20,000	30,000	30,000	$50,000.00
Demolition	1	LS			35,000	35,000	$35,000.00
Deaerator Repair	1	LS	5,000	5,000	7,500	7,500	$12,500.00
Chemical feed Equipment	3	EA	2,500	10,000	500	1,500	$9,000.00
Nitrogen Storage & Piping	1	LS	10,000	10,000	7,000	7,000	$17,000.00
					SUBTOTAL 1		$994,500.00
					5% SALES TAX		$40,075.00
					17% LABOR TAX		$32,810.00
					SUBTOTAL 2		$1,067,385.00
					20% GC OH & PROFIT		$213,477.00
					SUBTOTAL GC WORK		$1,280,862.00
					5% CONTINGENCY		$64,043.10
					TOTAL		$1,344,905.10

ECO 69A

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
2-1/2 Ton Heat pump (96 Bldg)	1	LS	19,200	19,200	24,000	24,000	$216,000.00
Piping & Pumps to Exist Tanks	1	LS	48,000	48,000	40,000	40,000	$88,000.00
FCU In Building	1	LS	30,000	30,000	20,000	20,000	$50,000.00
Electrical Work	1	LS	12,000	12,000	12,000	12,000	24,000.00
					SUBTOTAL 1		$378,000.00
					5% SALES TAX		$14,100.00
					17% LABOR TAX		$16,320.00
					SUBTOTAL 2		$408,420.00
					20% GC OH & PROFIT		$81,684.00
					SUBTOTAL GC WORK		$490,104.00
					5% CONTINGENCY		$24,505.20
					TOTAL		$514,609.20

ECO 69B

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Gas Piping (96 Bldgs)	1	LS	30,000	30,000	60,000	60,000	$90,000.00
Combustion Air Ventilation (96)	1	LS	5,000	5,000	9,600	9,600	$14,600.00
Gas Fired Water Heater (96 Bldg)	1	LS	20,000	20,000	12,400	12,400	$32,400.00
Piping To Existing Storage Tank	1	LS	30,000	30,000	25,000	25,000	$55,000.00
Pumps (96 Bldgs)	1	LS	9,600	9,600	5,000	5,000	$14,600.00
					SUBTOTAL 1		$206,600.00
					5% SALES TAX		$4,730.00
					17% LABOR TAX		$19,040.00
					SUBTOTAL 2		$230,370.00
					20% GC OH & PROFIT		$46,074.00
					SUBTOTAL GC WORK		$276,444.00
					5% CONTINGENCY		$13,822.20
					TOTAL		$290,266.20

ECO 71

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Repair Steam Leaks	50	HRS			25	1,250	$1,250.00
					SUBTOTAL 1		$1,250.00
					5% SALES TAX		
					17% LABOR TAX		$212.50
					SUBTOTAL 2		$1,462.50
					20% GC OH & PROFIT		$292.50
					SUBTOTAL GC WORK		$1755.00
					5% CONTINGENCY		$87.75
					TOTAL		$1,842.75

ECO 88

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Fuel Flow	1	LS	6,000	6,000	3,000	3,000	$9,000.00
Expansion Tank Temp & Pressure	1	LS	2,000	2,000	1,000	1,000	$3,000.00
Combustion Air & Flue Gas	1	LS	1,000	1,000	1,000	1,000	$2,000.00
HTW Pump Operation (T,P,F)	1	LS	3,000	3,000	4,000	4,000	$7,000.00
Make-Up Water (T,P,F)	1	LS	2,000	2,000	1,500	1,500	$3,500.00
Nitrogen Storage (Level, T,P)	1	LS	1,200	1,200	2,400	2,400	$3,600.00
Valve Positions	1	LS	1,000	1,000	2,000	2,000	$3,000.00
BTU Computation	1	LS	500	500	2,000	2,000	$2,500.00
Chemical Feed	1	LS	900	900	900	900	1,800.00
HW Generator Pumps Controls	1	LS	2,000	2,000	1,000	1,000	$3,000.00
HW Generator Combustion Eff.	1	LS	600	600	600	600	$1,200.00
Gauges & Dials	1	LS	4,000	4,000	4,000	4,000	$8,000.00
					SUBTOTAL 1		$47,600.00
					5% SALES TAX		$1,210.00
					17% LABOR TAX		$3,978.00
					SUBTOTAL 2		$52,788.00
					20% GC OH & PROFIT		$10,557.60
					SUBTOTAL GC WORK		$63,345.60
					5% CONTINGENCY		$3,167.28
					TOTAL		$66,512.88

/*

12A !CRITERIA FOR PROPOSED CONSTRUCTION

***Construction will occur inside the confines of the existing Building 25910. No additions to the exterior shell is required. Inside renovation work will conform to existing guidelines of architectural design and building construction, specifically the AEI Design Guide (March 1987), the Corps of Engineers Guide Specifications CEGS 13947 thru 13949 for Power Plant and EMCS requirements.

13B !FURNISHINGS AND EQUIPMENT DISCUSSION

***This ECIP consists of the following renovations and additions;

1) Replace 5 steam boilers with 3 HTHW boilers,
2) Add Variable Speed Drives for two pumps, and eliminate the need for a third existing pump,
3) Install new instrumentation and controls that will interface to the existing EMCS system at the base.

/*

15A !ENVIRONMENTAL DOCUMENTATION

***There will be no environmental impact to the modification, renovations and upgrades to the central utility plant heating system. Boilers being replaced will be dismantled and new high efficiency boilers, pumps and heat. The addition of chemical treatment system will be handled in accordance with state and federal regulations.

15B1 !SUMMARY OF ENVIRONMENTAL CONSEQUENCES

***We have reviewed this project and determine that an environmental impact statement, pursuant to PL 91-190, is not required. We have assessed this project and determined that it will not contribute significantly to air and/or water pollution.
/*

16A1 !EVALUATION OF FLOOD HAZARDS

***The renovation is to an existing plant. No history of flooding has been recorded.
/*

19A !SUMMARY OF ENERGY REQUIREMENTS

***Current Electrical oil and gas services are adequate to support the required upgrades to the heating system for the Central Utility Plant, Building 25910. There will be no changes or increased requirements for additional services. The demand for utility service will be reduced as the changes are implemented. See the cost and savings analysis for details.

19B !SUMMARY OF UTILITY SUPPORT

***No additional service will be required.

/RECALL F 000045555 S 20
20B !HAZARDS TO HANDICAPPED PERSONS

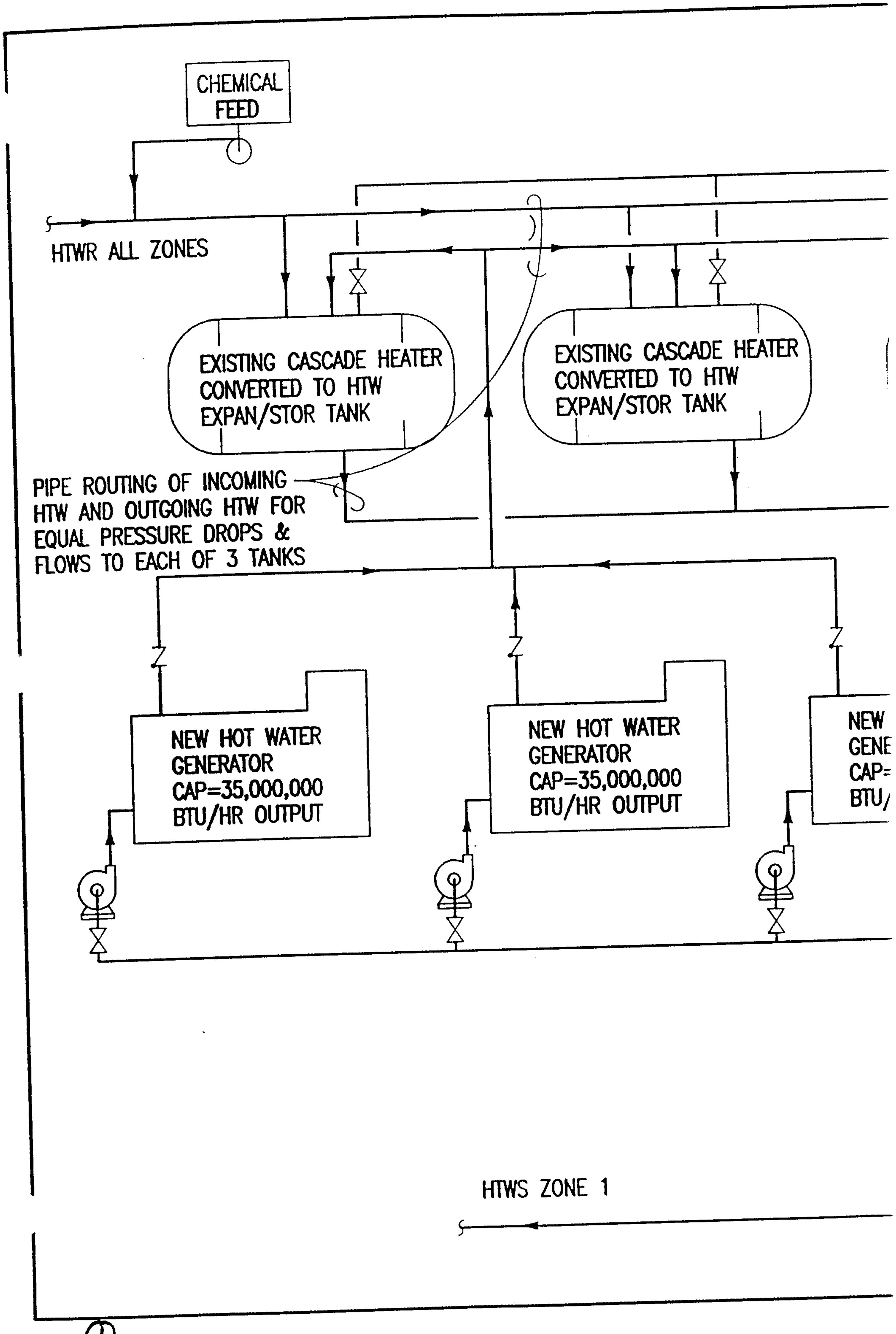
***Existing conditions within the physical plant is considered hazardous to unauthorized personnel. Signs and warnings are posted to alert unauthorized personnel access is restricted to authorized personnel and visitors with prior approval.

20C !HANDICAP PROVISIONS

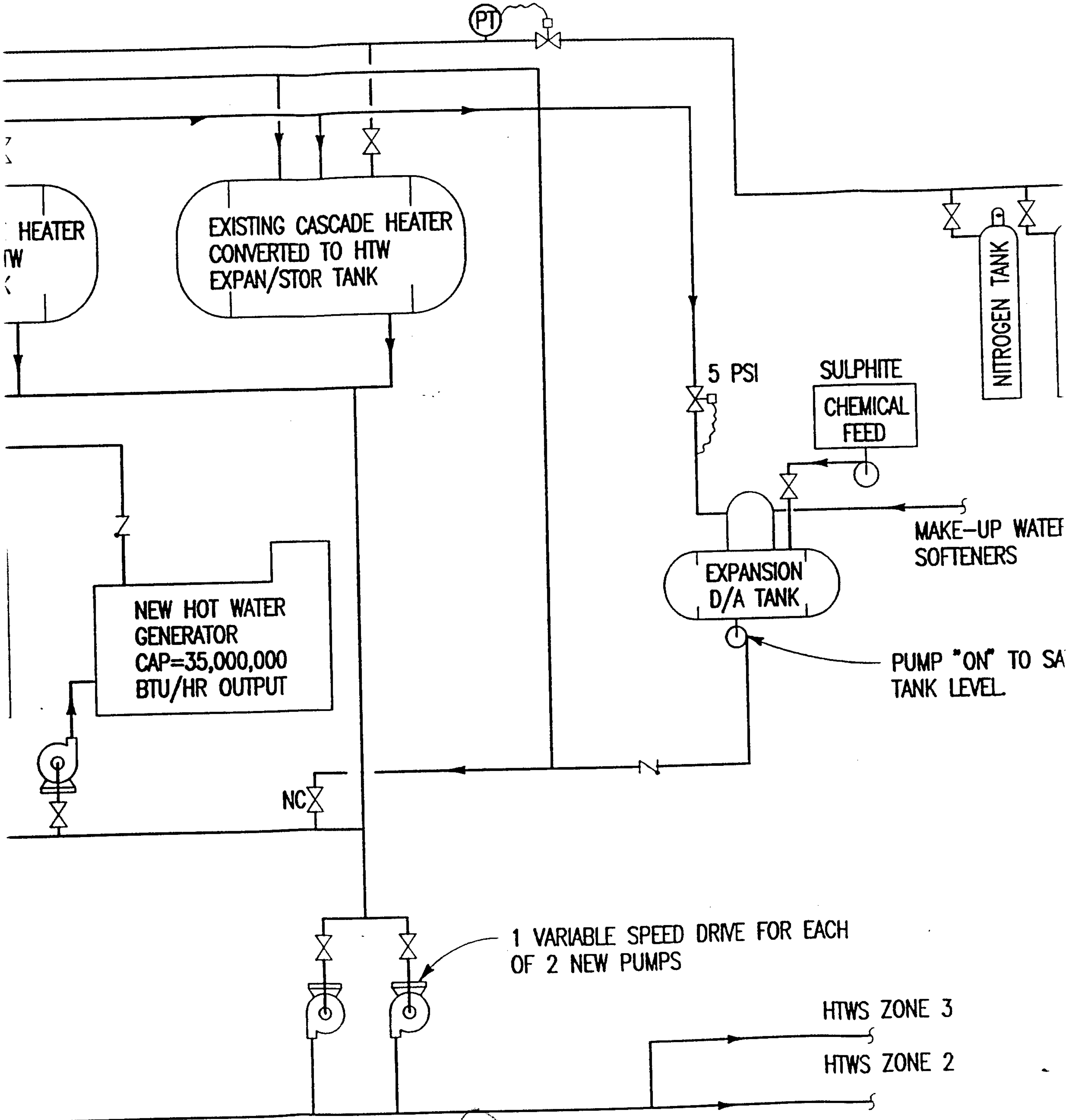
***In accordance with Public Law 90-480, no provisions for the handicapped will be made in the project since the facility is used and operated solely by able bodied personnel. However, the main floor of the facility is at ground level and is handicap accessible.
/*

22B !PHYSICAL SECURITY

***Project is not considered for commercial activity. The physical plant upgrade to the existing Central Utility Plant will serve the north side of Ft. Gordon. Provisions of DA circular 235-1 are not applicable to this project.
/*


CHEMICAL FEED
HTWR ALL ZONES
EXISTING CASCADE HEATER CONVERTED TO HTW EXPAN/STOR TANK
EXISTING CASCADE HEATER CONVERTED TO HTW EXPAN/STOR TANK
PIPE ROUTING OF INCOMING HTW AND OUTGOING HTW FOR EQUAL PRESSURE DROPS & FLOWS TO EACH OF 3 TANKS
NEW HOT WATER GENERATOR CAP=35,000,000 BTU/HR OUTPUT
NEW HOT WATER GENERATOR CAP=35,000,000 BTU/HR OUTPUT
NEW
HTWS ZONE 1

Project No. 3 HTW Schematic North-



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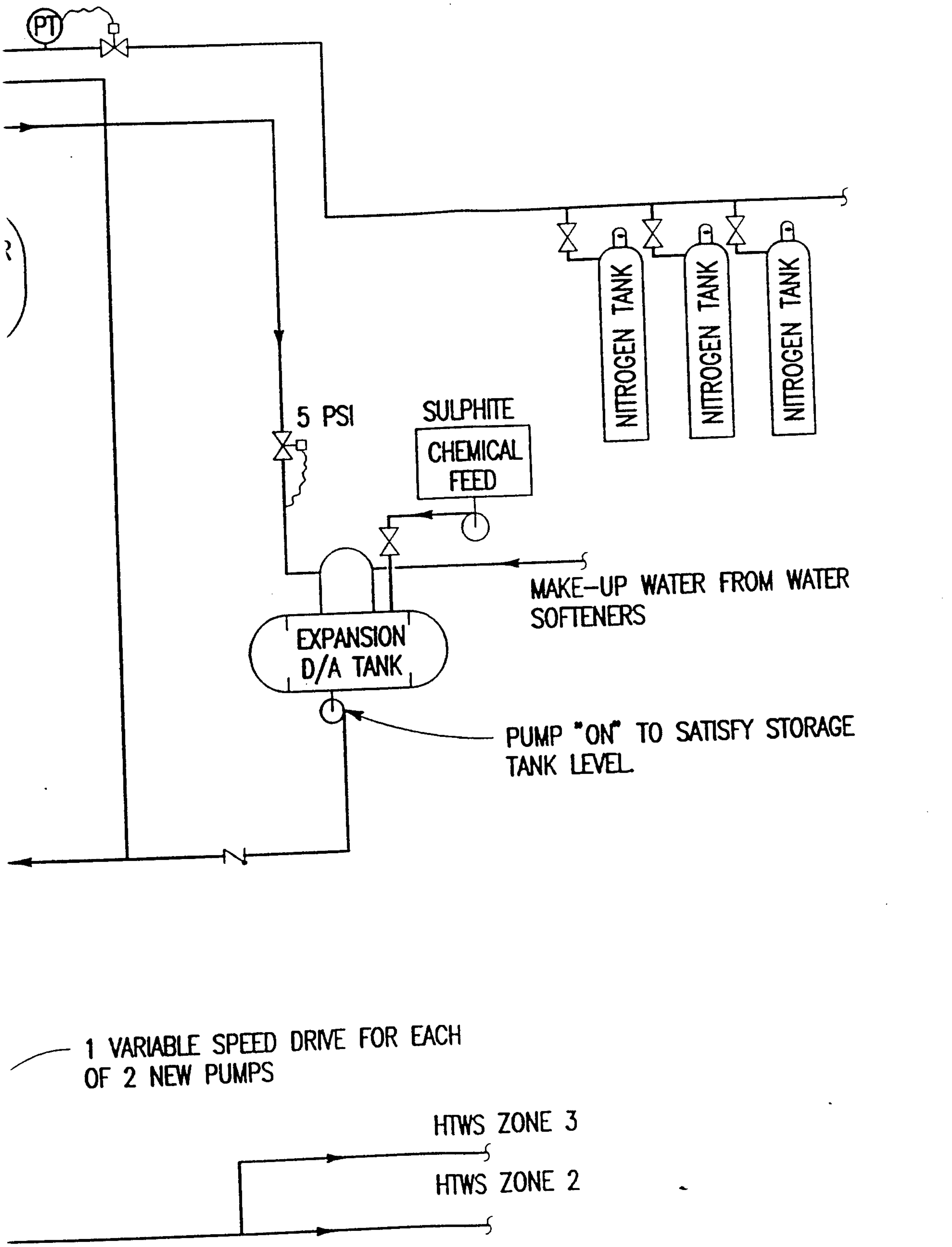
:t No. 3 HTW Schematic North-Bldg. 25910



LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: EC0025
LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 3 HTW NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: VARIABLE SPEED PUMPING
ANALYSIS DATE: 09-21-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 161421.		
B. SIOH	$ 8879.		
C. DESIGN COST	$ 9686.		
D. TOTAL COST (1A+1B+1C)	$ 179986.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 179986.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	785.	$ 11962.	15.61	$ 186729.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5209.	$ 11962.		$ 186729.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 4000.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 58960.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 58960.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 15962.

5. SIMPLE PAYBACK PERIOD (1G/4) 11.28 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 245689.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.37
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 4.72 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO027
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 3 HTW NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: CONTROLS
ANALYSIS DATE: 09-21-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 63315.		
B. SIOH	$ 3483.		
C. DESIGN COST	$ 3799.		
D. TOTAL COST (1A+1B+1C)	$ 70597.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 70597.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	2040.	$ 9181.	20.96	$ 192432.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-3954.	$ 9181.		$ 192432.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 10000.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 147400.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 147400.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 19181.

5. SIMPLE PAYBACK PERIOD (1G/4) 3.68 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 339832.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 4.81
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 11.53 %

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: EC0031
LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 3 HTW NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: REDUCE WATER
ANALYSIS DATE: 09-21-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 55112.			
B. SIOH	$ 3032.			
C. DESIGN COST	$ 3307.			
D. TOTAL COST (1A+1B+1C)	$ 61451.			
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$	0.	
F. PUBLIC UTILITY COMPANY REBATE		$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)				$ 61451.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	5588.	$ 25145.	20.96	$ 527032.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-406.	$ 25145.		$ 527032.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 1684.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 24827.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 24827.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 26829.

5. SIMPLE PAYBACK PERIOD (1G/4) 2.29 YEAR:

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 551858.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 8.98
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 15.06 %

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: ECO067
LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3.
PROJECT NO. & TITLE: 3 HTW NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: REPLACE BOILERS
ANALYSIS DATE: 09-21-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 1344905.		
B. SIOH	$ 73970.		
C. DESIGN COST	$ 80695.		
D. TOTAL COST (1A+1B+1C)	$ 1499570.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 1499570.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	15736.	$ 70812.	20.96	$ 1484222.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0
N. TOTAL		9742.	$ 70812.		$ 1484222

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 15000
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 221100

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. 5 BOILERS 10 YRS	$ 550000.	10	.74	407000.
2. 3 HW GEN 20 YRS	$-750000.	20	.54	-405000.
3. EXST ECON 2 YRS	$ 250000.	2	.94	235000.
4. PLT PIPG 15 YRS	$ 50000.	15	.63	31500.
5. PLT PIPG 20 YRS	$ -50000.	20	.54	-27000.
d. TOTAL	$ 50000.			241500.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) $ 46260

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd4/(YRS ECONOMIC LIFE)) $ 97887

5. SIMPLE PAYBACK PERIOD (1G/4) 15.32 Y

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 194682

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.30
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 4.45

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: ECO069A
LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 3 HTW NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: SUMMER SHUTDOWN-HEAT PUMPS
ANALYSIS DATE: 09-21-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 514609.		
B. SIOH	$ 15730.		
C. DESIGN COST	$ 17160.		
D. TOTAL COST (1A+1B+1C)	$ 547499.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 547499.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	1990.	$ 30326.	15.61	$ 473395.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	17162.	$ 77228.	20.96	$ 1618707.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		13158.	$ 107555.		$ 2092102.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 79975.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 1178832.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 1178832.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 187530.

5. SIMPLE PAYBACK PERIOD (1G/4) 2.92 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 3270933.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 5.97
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 12.74 %

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
STUDY: ECO069B
LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 3 HTW NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: SUMMER SHUTDOWN-GAS
ANALYSIS DATE: 09-21-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT			
A. CONSTRUCTION COST	$ 290266.		
B. SIOH	$ 15965.		
C. DESIGN COST	$ 17416.		
D. TOTAL COST (1A+1B+1C)	$ 323647.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 323647.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	17162.	$ 77228.	20.96	$ 1618707.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		11168.	$ 77228.		$ 1618707.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 79975.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 1178832.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 1178832.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 157203.

5. SIMPLE PAYBACK PERIOD (1G/4) 2.06 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 2797538.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 8.64
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 14.84 %

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: EC0069C
LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON   REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 3 HTW NORTH
FISCAL YEAR 1994   DISCRETE PORTION NAME: SUMMER SHUTDOWN-1/2 GAS, 1/2 HP
ANALYSIS DATE: 09-21-94   ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 402418.		
B. SIOH	$ 22133.		
C. DESIGN COST	$ 24145.		
D. TOTAL COST (1A+1B+1C)	$ 448696.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 448696.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	995.	$ 15163.	15.61	$ 236697.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	17162.	$ 77228.	20.96	$ 1618707.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		12163.	$ 92392.		$ 1855404.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 79975.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 1178832.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 1178832.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 172367.

5. SIMPLE PAYBACK PERIOD (1G/4) 2.60 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 3034235.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 6.76
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 13.44 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO071
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 3 HTW NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: STEAM LEAKS
ANALYSIS DATE: 01-13-95 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 1843.		
B. SIOH	$ 102.		
C. DESIGN COST	$ 111.		
D. TOTAL COST (1A+1B+1C)	$ 2056.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 2056.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	399.	$ 1794.	20.96	$ 37594.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5595.	$ 1794.		$ 37594.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 1794.

5. SIMPLE PAYBACK PERIOD (1G/4) 1.15 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 37594.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 18.29
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 19.22 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO088
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 3 HTW NORTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: EMCS CONTROLS/INTRUMENTATION
ANALYSIS DATE: 09-27-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 66513.		
B. SIOH	$ 3659.		
C. DESIGN COST	$ 3991.		
D. TOTAL COST (1A+1B+1C)	$ 74163.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 74163.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	4721.	$ 21244.	20.96	$ 445267.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-1273.	$ 21244.		$ 445267.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 21244.

5. SIMPLE PAYBACK PERIOD (1G/4) 3.49 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 445267.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 6.00
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 12.77 %

PROJECT NO. 4

HIGH TEMPERATURE WATER SOUTH

BUILDING 25330

GENERAL PROJECT NO. 4

GENERAL DESCRIPTION:

This project is intended to improve high temperature water (HTW) operating efficiency at the south distribution and its supply in Building 25330. Existing Plant Building 25330 supplies HTW year round to the south distribution system as opposed to chilled water from Building 25330 which is only supplied in the summer time. The HTW system serves barracks, offices, and recreational facilities. The existing boilers in the Plant are higher efficiency than those in Building 25910. As a means of comparison, the load is a lot less, although the two boilers in Building 25330 are equal in capacity to each of the five boilers in Building 25910. The difference is that the boilers in Building 25330 are made for gas-firing and are therefore more efficient than the converted Building 25910 boilers. However, in the interest of saving energy, we will replace those with a high temperature water system using hot water generators. When loads are calculated, the maximum load on the building is in the neighborhood of 7,000 lbs/hr. Factoring in the line loss and other things makes us want to select the 15,000,000 Btu per hour output for each generator. One generator will be used for the maximum load and the other will be used as a back-up. The hot water generator shall be on a loop which is taken out of the high temperature water fed from the bottom of the expansion/storage tanks going to the pumps and the loop returns to the top of the expansion/storage tank. The expansion tanks will be the existing cascade heaters converted for the new use. There will be nitrogen tanks supplying nitrogen that will keep a varying pressure on the tanks dependent on the water level within them. When make-up water is required because of a low level in the storage tank, the existing deaerator will process the water using high temperature water expanded to 5 psi which will then flash to steam. In this deaerator we will add sulphite to absorb any remaining oxygen, as well as chemicals to control the ph. That make-up water will then be fed either into the high temperature return line or to the water entering the hot water generators to make up the existing deficit in the storage tanks.

SUMMARY:

There are seven ECO's that comprise Project 4. As you can see from the data compilation on the next page, the payback is less than 5 years, and the SIR is a very good 3.71. All of the ECO's identified have an SIR greater than 1 except for ECO 68 which is the new hot water generators. It is necessary to keep ECO 68 in the project because the savings obtained by simplifying and improving temperature control in the system are all conditional upon having the hot water system rather than a steam system. Also, the life of the Plant in general will be much longer with hot water generators where steam treatment is not required and corrosion will be reduced even if the equipment is not treated properly, as is the present case with the equipment at Fort Gordon.

COMPILATION OF DATA:

The following two (2) pages show the ECO's that make up Project No. 4 and the life cycle cost analysis considering all ECO's as components of one (1) project.

CONCLUSION:

The summer shutdown is handled very much as it was handled in Project 3. There are many buildings that need to be modified to generate their own domestic water in the summer time so that the Plant can be shutdown thereby saving the line loss in the underground piping. To do this, we are not identifying which buildings need to be converted, but we have allowed for half of them to have gas domestic water heating and half to have heat pumps. Although heat pumps cost more, it is still a better choice where we can use the chilled air to offset some of the energy being used by the chilled water system now. We have put calculations in the report with all gas heating, and with all heat pumps, but we have selected the values for the ECO with half heat pumps and half gas for the summer domestic water heating.

LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: PROJ004
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 4 HTW SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: COMPOSITE
ANALYSIS DATE: 02-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 1105659.	
B. SIOH	$ 60812.	
C. DESIGN COST	$ 66340.	
D. TOTAL COST (1A+1B+1C)	$ 1232811.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 1232811.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	908.	$ 13831.	15.61	$ 215899.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	29156.	$ 131202.	20.96	$ 2749992.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		24070.	$ 145033.		$ 2965891.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 91286.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 1345556.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 1345556.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 236319.

5. SIMPLE PAYBACK PERIOD (1G/4) 5.22 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 4311447.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 3.50
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 9.76 %

PROJECT NO. 4 - HOT WATER SOUTH

ECO DATA COMPILATION

ECO NO.	DESCRIPTION	CONSTRUCTION COST	ANNUAL RECURRING COST	NON-RECURRING COST (-) SAVINGS (+)	TOTAL COST (From LCC)	ELECTRICAL SAVINGS MMBTU/YR	NAT GAS SAVINGS MMBTU/YR	SAVINGS 1st YEAR	TOTAL DISCOUNT SAVINGS
26	Variable Speed Pumping	23,980.00	0	0	26,738	379	0	5,771	90,086
28	Return Hot Water Temperature Control	48,573.00	600	0	54,160	0	3,045.32	14,304	296,079
32	Reduce Make-up Water	45,927.00	961	0	51,209	0	2,975.50	14,351	294,814
68	Hot Water Generators	694,840.00	10,000	0	774,748	0	4,662.00	30,977	587,085
70c	Summer Shutdown (1/2 gas, 1/2 hp)	244,294.00	79,725	0	272,389	529	15,477.00	157,426	2,760,665
72	Reduce Steam Leaks	1,290.00	0	0	1,439	0	199.00	897	18,797
89	EMCS Controls/Instrumentation	46,754.82	0	0	52,133	0	2,796.98	12,586	263,811
	Totals	1,105,659.00	91,286	0	1,232,816	908	29,155.80	236,312	4,311,334

Simple Payback: $\frac{1,232,816}{236,312} = 5.22$ yrs.

SIR: $\frac{4,311,334}{1,163,554} = 3.50$

ECO METHODOLOGY FORM

ECO NAME:	Variable Speed HTW Pumping
ECO NUMBER:	26
TYPE: BLDG SYSTEM:	Bldg. 25330 Heating

EXISTING CONDITIONS:

HTW water leaving Building 25330 is pumped with only one set of two identical pumps. The pumps are Ingersol-Rand 4 x 9A with a Louis Allis motor with a serial number of 5111871001 on one motor, and 5111871002 on the other. Type C004NB, 460 volts, 1.15 service factor, 4040 TS frame and the rating is 100 hp at 3550 rpm or 25 hp at 1776 rpm. One or the other of these pumps always operate at low speed. All buildings in the distribution system are equipped with 2-way valves so that when HTW is not required, the flow ceases to that building. Just upstream of the pump there is a blending station that mixes hot water return water before it gets heated with the heated HTW to control the temperature of the HTW leaving the Plant.

PROPOSED CHANGE:

Install one variable speed drive with switching so that either pump can be operated to supply the HTW needs of the distribution system. Using the existing pumps will require only one variable speed drive to be connected with switching to either one of the existing pumps with its existing motors. The Blending Station will be eliminated. Pumping speed will be varied to maintain a constant supply pressure, but as the total flow decreases with block valves closing the pump speed, the total developed head will decrease.

CALCULATION & COST METHODOLOGY

Because the pump always operates at low speed in the actual conditions, we will select the low speed information from the pump curve, which is 450 gpm at 70 ft. of head when using the existing motor which is 25 horsepower rated at 1750 rpm. Running the Bell & Gossett program using a heating profile, we can determine how often the pump will run at the various 10% increments of speed required to satisfy the south distribution HTW system. From the program run on the following pages we note that the pump on constant speed uses the same hp at all flows. But that hp is only .61 times the motor size. Since the motors were originally sized for 100 hp at high speed, it is NOT reasonable to assume at low speed, where only 25 hp is available, that 13.82 hp is actually consumed. Therefore, the full hp at low speed is assumed for constant speed operation. The power consumed is:

$$\frac{1\ \text{KW}}{1000\ \text{watts}} \times 800\ \text{KW/hp} \times 25\ \text{hp} \times 24\ \text{hrs/day} \times 365\ \text{days/yr} = 175{,}200\ \text{KWH/yr}$$

From the program printout the variable speed pump consumes only 64,218.95 KWH/yr.
The savings is the difference:
175,200 - 64,218.98 = 110,981.02 KWH

or $\frac{110{,}981.02}{10^6} \times 3413 = 378.78$ Million Btu/hr

Cost:

Variable speed drive

Materials	$11,000	Labor	$ 1,500

Necessary switches at the motor (2)

Materials	$ 4,340	Labor	$ 1,000

CONSTRUCTION COST ESTIMATE	DATE: 23 SEPT 94	SHEET 1 OF 1

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA — PROJ. NO. 4

Arch/Engr: HARRISON AND SPENCER, INC. — CODE: BLDG 25330

Summary: ECO #26 - VARIABLE HTW PUMPING — Estimator: H. TOUB — Checked:

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
VARIABLE SPEED DRIVE	1	LS	11,000	11,000	1,500	1,500	$12,500.00
SWITCHES	1	LS	4,340	4,340	1,000	1,000	$5,340.00
	SUBTOTAL			15,340		2,500	
	5% SALES TAX			$767.00			
	17% LABOR TAX					$425.00	
	SUBTOTALS			$16,107.00		$2,925.00	$19,032.00
	20% OH (GC ONLY)						$3,806.40
	SUBTOTAL GC'S WORK						$22,838.40
	SUBTOTAL(GC & SUBS)						$22,838.40
	10% GC'S PROFIT						
	5% CONTINGENCY						$1,141.92
	TOTAL						**$23,980.32**

B&G Pumping System Analysis: BLDG 25330 HEATING

SUMMARY OF INPUT DATA: Office, heating

System peak demand:	450.00 gpm	
System discharge pressure:	70.00 ft.	(30.32 psig)
Minimum control/Static pressure:	20.00 ft.	(8.66 psig)

Standard Efficiency (SE) 60-cycle motor.

1 Pump System:

Pump 1: Series 1510 5BC, Impeller diameter 8.875"
Design RPM = 1750.0, Motor HP = 20.00

CONSTANT SPEED OPERATION:

Hrs	Q/Qd,%	TGPM	TDH,ft	BHP	Ep,%	BHP/HP,m	HP,in	E,mtr,%	kWHR	$/day	E,w/w,%
2.40	20.0	90.0	72.0	12.20	13.4	0.610	13.82	88.3	24.7	0.99	11.8
2.40	40.0	180.0	72.0	12.20	26.8	0.610	13.82	88.3	24.7	0.99	23.7
3.60	50.0	225.0	72.0	12.20	33.5	0.610	13.82	88.3	37.1	1.48	29.6
4.80	60.0	270.0	72.0	12.20	40.3	0.610	13.82	88.3	49.5	1.98	35.5
4.80	70.0	315.0	72.0	12.20	47.0	0.610	13.82	88.3	49.5	1.98	41.5
2.40	80.0	360.0	71.9	12.20	53.6	0.610	13.82	88.3	24.7	0.99	47.3
2.40	90.0	405.0	71.8	12.20	60.2	0.610	13.82	88.3	24.7	0.99	53.1
1.20	100.0	450.0	71.5	13.30	61.0	0.665	15.08	88.2	13.5	0.54	53.8

COST SUMMARY:

Annual Operating Cost @ $0.04 / kwhr = $ 3626.57
8760 hours/year or 100.00%
Total annual operating cost = $ 3626.57
Total kW hours = 90664.32

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VARIABLE SPEED OPERATION: (Table 1 of 1)

System suction pressure: 0.00 ft. (0.00 psig)
Best Efficiency Staging is ON

Hrs	Q/Qd,%	TGPM	TDH,ft	BHP	Ep,%	RPM	HP,in	E,d/m,%	kWHR	$/day	E,w/w,%
2.40	20.0	90.0	22.0	2.11	23.7	965.9	2.84	74.3	5.1	0.20	17.6
2.40	40.0	180.0	28.0	5.38	23.7	1087.0	6.83	78.7	12.2	0.49	18.6
3.60	50.0	225.0	32.5	7.80	23.7	1176.3	9.68	80.5	26.0	1.04	19.1
4.80	60.0	270.0	38.0	10.94	23.7	1278.3	13.25	82.6	47.4	1.90	19.6
4.80	70.0	315.0	44.5	7.26	48.8	1380.3	8.58	84.6	30.7	1.23	41.3
2.40	80.0	360.0	52.0	8.93	52.9	1495.0	10.43	85.6	18.7	0.75	45.3
2.40	90.0	405.0	60.5	10.83	57.1	1609.8	12.54	86.4	22.4	0.90	49.3
1.20	100.0	450.0	70.0	13.04	61.0	1724.5	14.97	87.1	13.4	0.54	53.1

Annual Operating Cost @ $0.04 / kwhr = $ 2568.76
8760 hours/year or 100.00%
Total kW hours = 64218.98

COST SUMMARY:

Suction Pressure : 0.0 psig
Percent of Year : 100%
Hours/Year : 8760
Annual Operating Cost: $2568.76

Total hours/year = 8760
Total annual operating cost = $2568.76

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ECO METHODOLOGY FORM

ECO NAME: Controls For Return HTW Temperature Regulation

O NUMBER: 28

TYPE: BLDG Bldg. 25330
SYSTEM: Heating

EXISTING CONDITIONS:

HTW is heated in cascade heaters, which is usually maintained at the temperature of the saturation pressure of the boiler, and this boiler pressure is usually maintained except for several times a year when it is changed. At 150 psi, the saturation temperature is 347°F. When the HTW water leaves the cascade heaters, it passes through a blender that adds unheated HTW return to controls with setpoint that maintains the constant HTW supply temperature. Note that as distribution loads vary; less or more HTW water is required, and the HTW return temperature rises and falls depending upon the load. The existing system operates to control the HTW supply water, and does not take into account changes to load that would effect the overall heating requirements.

PROPOSED CHANGE:

Because the existing boilers are now going to be replaced with hot water generators, the controls in the Control Room will basically have to be changed. The controls will now regulate the high temperature water supply temperature, which will be based on firing the hot water generators to maintain the temperature in the storage tanks. This water will be circulated through the distribution system, and the firing rate of the hot water generators will be maintained based on a setpoint for the high temperature water supply. The HTW supply temperature set point will be varied by the EMCS to maintain the lowest acceptable HTW return temperature to adequately serve all buildings on the distribution system. These controls will also be monitored and, in some cases, controlled by the EMCS system so that temperatures in various buildings will establish energy efficient setpoint temperatures for high temperature water supply in a very short time by this monitoring at the EMCS. Therefore, this ECO, including the cost of new Control Room controls and the tie-ins to the EMCS, will be in the Control Room only. ECO 89 that includes new EMCS controls will cover the cost of any wiring from the Control Room to the EMCS system. The HTW return water temperature will also be monitored at the EMCS. The EMCS personnel will provide an HTW supply setpoint temperature based on their experience and time of day usage of high temperature water throughout the distribution system.

CALCULATION & COST METHODOLOGY:

Using the calculation method shown for ECO 27 in Project No. 3 for the line loss and knowing that the summer time gas usage is almost equal in both distribution systems (North and South), the line loss is calculated using the same ratios used in Project No. 3.

Savings: Line loss is reduced from an average of 255°F to 230°F (.1087 reduction). Since the minimum summer HTW usage is 4968 MCF of gas per month which is actually higher than the longer north distribution system it is assumed that the line loss is 60% or this total instead of the 75% assured in Project No. 3. The boiler efficiencies are 78% so the savings are:

$$\frac{4968 \text{ MCF} \times 1000 \text{ CF/MCF} \times 1030 \text{ Btu/CF} \times .75 \text{ Boiler Eff}}{24 \text{ hrs/day} \times 30 \text{ days/month}} = 5{,}330{,}250 \text{ Btu/Hr}$$

At 60% line loss:

$.6 \times 5{,}330{,}250$ Btu/Hr $= 3{,}198{,}150$ Btu/Hr or 3.198 Million Btu/Hr

The reduction in line loss is :

$.1087 \times 3.326$ Million Btu/hr $= .3476$ Million Btu/hr

Line loss at 8760 Hrs/Year the Total Savings is 3045.32 Million Btu's/yr.

<u>Cost:</u>

Controls:

Materials	\$20,000	Labor	\$15,000

Since the plant has new controls with computerized readout, the boiler controls simplifications suggest by this ECO will reduce maintenance time by only \$600/yr.

CONSTRUCTION COST ESTIMATE | **DATE:** 23 SEPT 94 | **SHEET 1 OF 1**

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA | **PROJ. NO.** 4

Arch/Engr: HARRISON AND SPENCER, INC. | **CODE:** BLDG 25330

Summary: ECO #28 - TEMPERATURE CONTROLS | **Estimator:** H. TOUB | **Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
CONTROLS	1	LS	20,000	20,000	15,000	15,000	$35,000.00
	SUBTOTAL			20,000		15,000	
	5% SALES TAX			$1,000.00			
	17% LABOR TAX					$2,550.00	
	SUBTOTALS			$21,000.00		$17,550.00	$38,550.00
	20% OH (GC ONLY)						$7,710.00
	SUBTOTAL GC'S WORK						$46,260.00
	SUBTOTAL(GC & SUBS)						$46,260.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$2,313.00
	TOTAL						**$48,573.00**

ECO METHODOLOGY FORM

ECO NAME:	Reduce Make-Up Water in HTW System
ECO NUMBER:	32
TYPE: BLDG SYSTEM:	Bldg. 25330 Heating
EXISTING CONDITIONS:	The total number of gallons lost in Building 25330 over the course of 1992 averages 43,663 gallons per month except for September where the very high recorded leakage is suspect. This leakage is caused by pipe failures and operating inefficiencies in the system. The quantity of lost water is based on reports of water meter readings made by the boiler operators.
PROPOSED CHANGE:	It is proposed that flow meters and temperature gauges be installed at various locations throughout the HTW distribution piping so that actual flows can be measured to determine where water is not being returned from where it is supplied. New flow meters and temperature gauges will be included in the cost of this ECO, and the wiring from them to the EMCS system will be included in ECO 89 in this Project No. 4.
CALCULATION & COST METHODOLOGY:	The cost is based on locating flow meter and temperature RTD's in various distribution locations throughout the HTW distribution piping. Once they are located in this ECO, ECO 89 for EMCS wiring will absorb the cost to wire them to the nearest building and then go back to the EMCS system. Savings is the heat loss of the water lost from the HTW system that can be determined and is based on the following:

Make-Up Water From Log Sheets

		Gallons
January		56,451
February		19,400
March		57,910
April		30,430
May		23,900
June		16,640
July		20,110
August		45,420
September		683,080
October		80,310
November		67,630
December		62,100
	Total	1,163,381 gal/yr
	Total Not Including Sept.	480,301 gal/yr

1,163,381 gal. x 8.34 lb/gal x (300°-70°Δt) = 2.2316 x 10^9 Btu/yr
or 22316 therms/yr

Gas to make up loss of heat:

$\frac{22316 \text{ Therms}}{.75 \text{ Boiler Eff.}}$ = 29,755 therms or 2,975.5 Million Btu/yr. @ $.45/therm = $13,389.60/yr

Also, 1,163,381 gal x $.826/1000 gal = $960.95 yr. is the annual recurring cost savings available for the water purchase cost to replace the leaked water.

CONSTRUCTION COST ESTIMATE			DATE: 23 SEPT 94		SHEET 1 OF 1		
Project: FORT GORDON ENERGY STUDY							
Location: AUGUSTA, GEORGIA					PROJ. NO. 4		
Arch/Engr: HARRISON AND SPENCER, INC.					CODE: BLDG 25330		
Summary: ECO #32 - REDUCE MAKE-UP WATER	Estimator: H. TOUB				Checked:		

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
FLOW METERS	10	EA	1,500	15,000	1,000	10,000	$25,000.00
TEMP RTD IN DISTRIBUTION PIPE	10	EA	300	3,000	500	5,000	$8,000.00
	SUBTOTAL			18,000		15,000	
	5% SALES TAX			$900.00			
	17% LABOR TAX					$2,550.00	
	SUBTOTALS			$18,900.00		$17,550.00	$36,450.00
	20% OH (GC ONLY)						$7,290.00
	SUBTOTAL GC'S WORK						$43,740.00
	SUBTOTAL(GC & SUBS)						$43,740.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$2,187.00
	TOTAL						**$45,927.00**

ECO METHODOLOGY FORM

ECO NAME: Replace Existing Boilers with Hot Water Generators

ECO NUMBER: 68

TYPE: BLDG Bldg. 25330
SYSTEM: Heating

EXISTING CONDITIONS: Existing boilers are gas-fired with oil back-up. The steam generators are operating as intended. Efficiency testing that was reported by Gee Jenson shows the boilers in Building 25330 operate at approximately 75% efficiency at 100% - 25% capacity.

PROPOSED CHANGE: The existing boilers will be removed and replaced with 15,000,000 Btu's/hr output hot water generators. The hot water generators shall be piped as shown on the drawing for Project No. 4 included in this project write-up. The project shall be such that the cascade heaters will be converted to expansion/storage tanks with the nitrogen pressure above. Water will flow down from the storage tanks into the existing pumps that will now be variable speed driven. Off of that line going down to the pumps will be a loop that goes through the hot water generators. The generators will have their own pumps to circulate HTW back into the expansion/storage tanks so that the hot water generators will come on only to heat the water in the storage tanks. The water will then leave the expansion tanks as required by either the hot water generators or the variable speed pumps. This means that the supply HTW temperature will be the controlling item for the variable speed pumping and the controls that are addressed in ECO 28 will assure that the return temperature is adequate to supply heat to all users. The existing deaerator can be reused. HTW water will have its pressure reduced to 5 psi which will allow it to flash to steam. That steam will be used to remove oxygen in the deaerator as the deaerator now operates. Additionally, there will be a sulphite chemical storage tank which will add sulphite to the deaerator process to remove any remaining oxygen at that point. An additional chemical storage pump and tank will be used to control the PH in the system at the deaerator tank and there will be a chemical feed tank that supplies a pipe preservative-type chemical for the distribution system, which will be pumped into the HTW return water.

The proposed system will have to be installed piece-meal so that the system operates as it currently does on steam. Converting one new hot water generator with one cascade heater at a time will allow the system to be converted over to hot water generation rather than steam generation with a relatively short shutdown period. Part of Project No. 4 allows for a summer shutdown of the Plant by installing hot water generating equipment at the various buildings. If this is done, there will be a longer shutdown to allow the Plant to be converted to hot water generation. The hot water generators selected for this project are those of the type produced by the International Boiler Company. These are truly hot water generators and not steam boilers that are converted for hot water generation use. Converted steam boilers will be less expensive, but they do not have the life nor are they specifically designed for the generation of the hot water. These new hot water generators are rated presently by International Boiler Company at 80% efficiency.

CALCULATION & COST METHODOLOGY: The new high temperature hot water generator will produce hot water at 80% efficiency as rated by the company that supplies them. Calculations done by Gee Jensen indicate that the existing boilers are 75% efficiency at the expected capacities they are running now which is in the neighborhood of 20% to 25%. As unbelievable as these figures may be, we still use them to determine the savings. Because of these low savings, the payback on this particular ECO does not appear to be as good as the other ECO's, but it is important that this ECO be implemented because other savings will be generated with controls changes and with a system that allows us to reduce operating temperatures in the plant and the distribution piping. The use of direct circulating hot water generators in lieu of steam at higher than necessary temperatures allows total savings that justify the entire Project No. 4.

ECO METHODOLOGY FORM

ECO NAME:	Replace Existing Boilers with Hot Water Generators (Cont'd)
ECO NUMBER:	68
TYPE: BLDG	Bldg. 25330
SYSTEM:	Heating
CALCULATION & COST METHODOLOGY:	

Savings is shown as 80% - 75% = 5%

$$\frac{90{,}517 \text{ MCF} \times 1{,}030{,}000 \text{ Btu/MCF}}{100{,}000 \text{ Btu/therms}} \times .05 = 46{,}616.26 \text{ therms} = 4{,}661.63 \text{ Million Btu/yr.}$$

46,616.63 therms @ $.45/therm = $20,977.32/yr

Maintenance manhour savings are $10,000/yr at 400 hrs x $25/hr.

Cost:

Hot water generators (2)			
Materials	$175,000 ea.	Labor	$ 65,000
Repiping of Cascade Heaters			
Materials	$ 6 ,000	Labor	$ 8,000
Controls for hot water generator			
Materials	$ 25,000	Labor	$ 20,000
Demolition		Labor	$ 15,000
Chemical Feed Equipment (3)			
Materials	$ 7,500	Labor	$ 1,500
Nitrogen Storage and Piping			
Materials	$ 8,000	Labor	$ 6,000

CONSTRUCTION COST ESTIMATE					DATE: 23 SEPT 94		SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY							
Location: AUGUSTA, GEORGIA					PROJ. NO. 4		
Arch/Engr: HARRISON AND SPENCER, INC.					CODE: BLDG 25330		
Summary: ECO #68 - H. W. GENERATORS		Estimator: H. TOUB			Checked:		

ITEM DESCRIPTION	QUANTITY QUAN UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
HOT WATER GENERATOR	2 EA	175,000	350000	LUMP SUM	65,000	$415,000.00
REPIPING OF CASCADE HEATER	1 LS	6000	6000	8000	8000	$14,000.00
CONTROLS FOR HOT WATER GENERATOR	1 LS	25,000	25000	20,000	20000	$45,000.00
DEMOLITION	1 LS			15000	15000	$15,000.00
CHEMICAL FEED EQUIPMENT	3 LS	2,500	7500	500	1500	$9,000.00
NITROGEN STORAGE & PIPING	1 LS	8,000	8000	6000	6000	$14,000.00
	SUBTOTAL		396,500		115,500	
	5% SALES TAX		$19,825.00			
	17% LABOR TAX				$19,635.00	
	SUBTOTALS		$416,325.00		$135,135.00	$551,460.00
	20% OH (GC ONLY)					$110,292.00
	SUBTOTAL GC'S WORK					$661,752.00
	SUBTOTAL(GC & SUBS)					$661,752.00
	10% GC'S PROFIT					
	5% CONTINGENCY					$33,087.60
	TOTAL					**$694,839.60**

ECO METHODOLOGY FORM

ECO NAME: Summer Shutdown of HTW System

ECO NUMBER: 70

TYPE: BLDG South Distribution
SYSTEM: Heating

EXISTING CONDITIONS: Space heating is not required from mid-May through the end of September, but a boiler must be in operation to handle domestic water needs and cooking requirements in some cases with the HTW distribution system.

PROPOSED CHANGE: Provide onsite water heaters at each building for domestic water usage. Water heaters should be about 10% more efficient than the boiler plant, i.e., 80%. Use of water heaters should also eliminate the heat loss in the distribution line during this 4-1/2 month period. It will also eliminate supervision of the boilers for 4-1/2 months. The HTW system should either be left full of water or pressurized with nitrogen to avoid corrosion during the period of non-use. The buildings will have hot water generating equipment, which will be heat pumps or gas-fired equipment . The heat pump operates at a COP of 3±. Cool air generated by the heat pump can be used in the buildings to cool air spaces that would not now be cooled or that can be cooled depending on domestic water demand rather than space conditions, i.e., Laundry Room, Hallways, or unused Classroom areas. In some buildings, the cool air generated by the heat pumps controlled to make domestic hot water can be used to supplement the large air handling units so that less chilled water from the CHW distribution system will be required. When this is done, warm air must always be available for domestic water heating regardless of the demand for space cooling in the building. Gas-fired equipment will be more expeditious where there is no use for the chilled air in the building being converted. Each building type should be evaluated with a life cycle cost analysis to see if the higher initial cost of the heat pump and associated equipment results in enough extra energy savings to warrant the extra cost.

CALCULATION & COST METHODOLOGY: Methodology for computing the savings for the summer shutdown is based on taking the total amount of gas used during the summer months, May through September, and subtracting from that the estimated hot water consumption in all of the buildings on the distribution system, including heat loss in the hot water storage tanks in all of the buildings. Since there is no space heating during these months, the difference between the domestic water heat use and the total HTW heating will be the amount of line loss in the distribution system for HTW. In addition to the savings of line loss of the HTW distribution system, the individual equipment that will be put in the distribution system buildings will have an 80% efficiency whether it is gas-fired equipment or heat pumps that we calculate to have an equal operating cost to gas-fired equipment. Therefore, the calculations become the same. Taking an 80% efficiency for gas-fired equipment and a 2.7 COP for heat pump operation, and using the cost available we calculate below to see that the same cost is derived for both systems per Btu. Because the cost of a Btu is the same, we can therefore easily calculate the savings with gas-fired equipment, and will assume the heating with a heat pump is going to cost the same. Therefore, it comes to the same value for the energy saved. The total savings of the higher efficiency equipment is then added to the line loss which will be saved by shutting down the Main Plant, which gives a total savings in gas over the 4-1/2 month period in which the Main Plaint will be shut down. In addition to the energy savings, the manpower at the Plant can be reduced by one man for 4-1/2 months at $25/hour. We have added back in some money for shutting down the Plant and isolating the piping which will not be used during the HTW shut down. Separately, heat pumps are compared with natural gas-fired water heaters for the summer heating in each of the buildings. The heat pumps are creating hot water, as well as cold air, so the cold air is for free because the heating with the heat pumps is exactly equivalent to the heating with natural gas. Cost of gas heaters in each of the buildings is then worked up, and the cost of the heat pumps is worked up.

ECO METHODOLOGY FORM

ECO NAME:	Summer Shutdown of HTW System (Cont'd)
ECO NUMBER:	70
TYPE: BLDG SYSTEM:	South Distribution Heating
CALCULATION & COST METHODOLOGY:	

Three life cycle cost analyses are shown with this ECO. ECO 70A is worked up for using heat pumps only in all the 96 buildings that need to be modified for summer usage. ECO 70B is worked up for gas used to generate hot water in all of the 96 buildings. ECO 70C is taking the cost of both of the two options and dividing it by 2, assuming half the buildings will require heat pumps and half the buildings will require gas. The savings for ECO 70C will be full savings of natural gas which will be shutting down the Plant, and half of the savings allocated to the free cooling will be derived by using heat pumps. Heat pumps vs. gas-fired equipment will be determined by looking at each individual building and determining if there is the possibility of using heat pumps to generate cooling so that they can decrease the cooling load and also take advantage of the fact that we got this cooling as a by-product by producing hot water in the summer time. The purpose of this calculation assumes that half of the buildings qualify for heat pumps and half of the buildings qualify for gas-fired equipment.

From weather data TM 5-785 it appears heat would not be needed for half of May and all of June, July, August, and September which is 4-1/2 months.

From 1992 Boiler Logs Heating Plant Gas Consumption for Months:

May	-	4878 MCF x 0.5 =	2439	MCF
June	-	=	4877	MCF
July	-	=	4335	MCF
Aug	-	=	4261	MCF
Sept	-	=	4137	MCF
			20,049	MCF

Estimated Hot Water Consumption = 40,708 GPD

$$Q = 1 \text{ BTU} \times 40{,}708 \text{ gal} \times 8.34 \text{ lb/gal} \times 60°\text{F} = 20{,}370 \text{ MBTU/day}$$

Tank loss (from 25910 calculation) = 18,000 Btu/day x 51 Bldgs. = 918 MBtu/day
Total net/day = 20,370 + 918 = 21,288 MBtu/day
With η = 0.75 = 28,384 MBtu/day

CF Gas = 28,384 x 1.03 = 29,236 CF/day
30 day/mo = 877.1 MCF/mo

Lowest recorded gas consumption, SCFT = 4137 MCF
Line and system loss = lowest record - est. HW consumption =
4137 MCF - 877.1 MCF = 3260 MCF

Gas savings due to increased η

$$\frac{21288 \text{ MBtu/day}}{.80} = 36.610 \text{ MBtu/day}$$

$$\times\ 30 \text{ days/mo} = 798.3 \text{ MCF/mo}$$

Savings due to increased η
877.1 - 798.3 = 78.8 MCF

Total savings for 4-1/2 month period

Line/system losses = 3260 x 4.5 =	14,671 MCF
Increased η = 78.8 x 4.5 =	355 MCF
	15,026 MCF

ECO METHODOLOGY FORM

ECO NAME: Summer Shutdown of HTW System (Cont'd)

ECO NUMBER: 70

TYPE: BLDG South Distribution

SYSTEM: Heating

CALCULATION & COST METHODOLOGY

Annual Savings:

- Fuel: 15026 MCF = 154,768 therms @ 1,030 Million Btu/CF (15,476.8 Million Btu/yr) @ $0.45/therm = $69,645

- Operator Hrs Saved: 3240 hrs @ $25/hr = $81,000 (1 man x 24 hrs/day x 30 day/mo x 4.5 hrs)

Additional Annual Cost:

- Labor to shut down, 1500 Ft and reactivate plant annually
  @ 1.0 hrs per building
  .51 hrs @ $25/hr = $ 1,275
  Net annual labor savings = 81,000 - 1275 $79,725

Domestic Water Calculations (Gas vs. Heat Pump)
Heat Pump at 2.7 COP (Min)

Electricity Cost is $\frac{\$.052/KW}{3413\ Btu/Hr \times 2.7COP} = \$.0000056/Btu$

Natural Gas Cost is $\frac{\$.45/100{,}000\ Btu}{.80\ Eff} = \$.0000056/Btu$

Additional Savings for Heat Pump Cooling:
Therefore, cost of energy at Fort Gordon is the same for gas heating at 80% efficiency or with an electric heat pump at a 2.7 COP. But with heat pump we get free cooling of space at

$\frac{30{,}000\ Btuh}{12{,}000\ Btu/ton} = 2.5\ ton \times .75\ KW/ton \times \$.052/KWH = \$.0975/hr$

2.5 tons x .75 KW/ton x 51 bldgs x 24 hr/day x 30 days/mo x 4.5 mo/yr = 309,825.0 KWH/yr

or 309,825 KW x $\frac{3413}{10^6}$ Btu/KW = 1057.4327 Million Btu/yr.

ECO 70A: Consider heat pumps in all 51 buildings. The cost of the modifications is a percentage of the costs used for ECO 69A in Project No. 3 except that a higher cost for fan coil units is inserted because some modifications are already made to buildings in the North distribution system.

The savings are the line loss in the HTW distribution, plus the higher efficiency of the local equipment when compared to the HTW Plant equipment. This savings value is 15,476.8 million Btu/yr for gas. There is an electrical savings also for heat pumps because we get space cooling that will reduce the Btu's distributed from the Plant. This savings is 1057.43 million Btu/yr.

ECO 70B: Consider gas-fired domestic water heating equipment in all 51 buildings. The gas savings will be the same as in ECO 70A, but there will not be the electric savings because we get no free cooling as we do with heat pumps. The cost of equipment is a pro rata cost difference from that figured for ECO 69B on the North HTW distribution loop in Project No. 3.

ECO METHODOLOGY FORM

ECO NAME:	Summer Shutdown of HTW System (Cont'd)			
ECO NUMBER:	70			
TYPE: BLDG SYSTEM:	South Distribution Heating			
CALCULATION & COST METHODOLOGY	Cost for Gas Heater:			
	Gas Piping x 51 Buildings Materials	$16,000	Labor	$32,000
	Combustion Air Ventilation 51 Buildings Materials	$ 2,600	Labor	$ 5,000
	Gas-Fired Water Heater (51) x Materials	$11,000	Labor	$ 7,000
	Piping To Existing Storage Tanks Materials	$17,000	Labor	$14,000
	Pumps 1 x 96 Materials	$ 5,000	Labor	$ 3,000

ECO 70C:

This ECO is a composite of ECO 70A and ECO 70B and it is the values that will be used for this Project No. 4. We will use an average cost of gas and heat pumps and we will use the same savings for line loss of the HTW, but will use only 1/2 of the free cooling savings for heat pumps because the basis of this ECO 70C is that 1/2 the buildings on the distribution system will use gas for domestic water heating and 1/2 will use heat pumps. The criteria for whether gas or heat pumps will be selected will depend on the existing equipment in each building on the HTW distribution system and whether there is a use for the free cooling that heat pumps can supply, but at a greater initial cost.

Cost:

Gas	158,193.00
Heat pumps	330,296.40
	488.489.40 ÷ 2 = 244,294.20

Savings:

Electric $\frac{1,057.43}{2}$ = 528.72 Million Btu/yr

Gas 15,476.8 Million Btu/yr

CONSTRUCTION COST ESTIMATE	DATE: 23 SEPT 94	SHEET 1 OF 1

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA — **PROJ. NO.** 4

Arch/Engr: HARRISON AND SPENCER, INC. — **CODE:** SOUTH DISTRIBUTION

Summary: ECO #70a - SHUTDOWN W/HEAT PUMP — **Estimator:** H. TOUB — **Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
2-1/2 TON HEAT PUMP (51 BUILDINGS)	1	LS	102,000	102,000	13,000	13,000	$115,000.00
PIPING & PUMPS TO EXIST TANKS	1	LS	25500	25,500	21500	21,500	$47,000.00
FCU IN BUILDING	1	LS	40,000	40,000	25,000	25,000	$65,000.00
ELECTRICAL WORK	1	LS	7500	7,500	7500	7,500	$15,000.00
	SUBTOTAL			175,000		67,000	
	5% SALES TAX			$8,750.00			
	17% LABOR TAX					$11,390.00	
	SUBTOTALS			$183,750.00		$78,390.00	$262,140.00
	20% OH (GC ONLY)						$52,428.00
	SUBTOTAL GC'S WORK						$314,568.00
	SUBTOTAL(GC & SUBS)						$314,568.00
	10% GC'S PROFIT						
	5% CONTINGENCY						$15,728.40
	TOTAL						**$330,296.40**

CONSTRUCTION COST ESTIMATE			DATE: 23 SEPT 94		SHEET 1 OF 1		
Project: FORT GORDON ENERGY STUDY							
Location: AUGUSTA, GEORGIA					PROJ. NO. 4		
Arch/Engr: HARRISON AND SPENCER, INC.					CODE: SOUTH DISTRIBUTION		
Summary: ECO #70b - SHUTDOWN W/ GAS		Estimator: H. TOUB			Checked:		
ITEM DESCRIPTION	QUANTITY QUAN UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL	
GAS PIPING (51 BLDGS)	1 LS	16,000	16,000	32,000	32,000	$48,000.00	
COMBUSTION AIR VENTILATION (51 BLDGS)	1 LS	2600	2,600	5000	5,000	$7,600.00	
GAS FIRED WATER HEATER (51 BLDGS)	1 LS	11,000	11,000	7,000	7,000	$18,000.00	
PIPING TO EXISTING STORAGE TANK	1 LS	17000	17,000	14000	14,000	$31,000.00	
PUMPS (51 BLDGS)	1 LS	5000	5,000	3000	3,000	$8,000.00	
	SUBTOTAL		51,600		61,000		
	5% SALES TAX		$2,580.00				
	17% LABOR TAX				$10,370.00		
	SUBTOTALS		$54,180.00		$71,370.00	$125,550.00	
	20% OH (GC ONLY)					$25,110.00	
	SUBTOTAL GC'S WORK					$150,660.00	
	SUBTOTAL(GC & SUBS)					$150,660.00	
	10% GC'S PROFIT						
	5% CONTINGENCY					$7,533.00	
	TOTAL					**$158,193.00**	

ECO METHODOLOGY FORM

ECO NAME:	Reduce Steam Leaks
ECO NUMBER:	72
TYPE: BLDG SYSTEM:	Bldg. 25330 Heating
EXISTING CONDITIONS:	There are steam leaks at steam valves and one hole was found in the cascade heaters. There are less leaks in this building than in Building 29510.
PROPOSED CHANGE:	Weld holes closed and replace packing in leaking valve stems. High pressure water will flash to steam at leaks to atmospheric pressure.
CALCULATION & COST METHODOLOGY:	Estimated steam loss is:

$$\frac{25\ \text{lbs/hr} \times 24\ \text{hr/day} \times 365\ \text{days/yr} \times 910\ \text{Btus/lb}}{100{,}000\ \text{Btus/therm}} = 1{,}992.9\ \text{therms} = 199.3\ \text{Million Btu/yr}$$

$\$.45$/therm x 1,992.9/therms = $896.811/yr

Cost of Repairs:

35 hrs @ $25 = $875

CONSTRUCTION COST ESTIMATE | **DATE:** 23 SEP 94 | **SHEET 1 OF 1**

Project: FORT GORDON ENERGY STUDY

Location: AUGUSTA, GEORGIA | **PROJ. NO.** 3

Arch/Engr: HARRISON AND SPENCER, INC. | **CODE:** BLDG 25330

Summary: ECO72 - REDUCE STEAM LEAKS | **Estimator:** H. TOUB | **Checked:**

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
REPAIR STEAM LEAKS	35	HRS			25	875	$875.00
	SUBTOTALS 1					$875.00	$875.00
	5% SALES TAX						
	17% LABOR TAX					$148.75	$148.75
	SUBTOTALS 2					$1,023.75	$1,023.75
	20% GC OH & PROFIT						$204.75
SUB-CONTRACTORS	SUBTOTAL GC WORK						$1,228.50
	TOTAL SUB WORK						
	10% GC SUB PROFIT						
	5% CONTINGENCY ON JOB						$61.43
	TOTAL						$1,289.93

ECO METHODOLOGY FORM

ECO NAME:	EMCS of Boiler and Chiller Controls vs. Manual Control
ECO NUMBER:	89
TYPE: BLDG SYSTEM:	Bldg. 25330 Heating

EXISTING CONDITIONS:

Existing automatic or manual controls are within the plant only with no EMCS tie-in for control. The EMCS office which is manned 24 hours a day has very few, if any instrumentation readouts from the plant, and no control of the plant with the EMCS. Because EMCS personnel are aware of what is happening in many buildings, they are also aware of conditions and demands on the high temperature water system. Currently, the boiler operators are making boiler pressure changes, HTW changes, bringing on and off boilers, and many manual valving operations. However, they are not performing the functions that an EMCS office can to control the energy consumed and to improve the operating efficiency of the Plant. The controls in Building 25330 have recently been upgraded and additions for EMCS points and new points are more readily available than in other places. Therefore, the amount of points necessary to be added is minimal. There is a computer existing that can currently read out large quantities of information.

PROPOSED CHANGE:

Connect most instrumentation and automatic controls and setpoint adjustments to the computerized EMCS system that is existing. EMCS personnel can then adjust HTW temperatures and temperature setpoints, and all new controls that may be added under other ECOs. All temperature, pressure and flow readings of new and existing instrumentation should be readable at the EMCS terminals. The individual that attends the plant but is not an EMCS operator shall have access to the readouts, but shall basically do maintenance most of the time, and turn on and off the equipment as required by the EMCS people. In addition to EMCS controls, there are also temperature gauges and dials that will be added so that Plant personnel can read exactly what is happening at any given time. Prior to actual designing this system, a thorough investigation should be made of the new controls system that has been added to see how much of that information could be fed directly into the EMCS and how much needs to be modified with in-house software to be installed in the computer within Building 25330.

CALCULATION & COST METHODOLOGY:

Required EMCS controls and instrumentation for the high temperature water system at Building 25330 with new hot water generators.

DESCRIPTION	NO. POINTS	DOLLARS
Fuel flow	4	$ 6,000
Expansion Tank (temperature and pressure)	4	2,000
HTW pump operation (temperature, pressure, flow)	10	5,000
Make-up water (temperature, pressure, flow)	3	3,500
Nitrogen (level, temperature, pressure)	3	2,500
Valve positions	7	2,000
Btu computation	--	2,500
Chemical feed	8	1,800
Hot water generator pump controls	6	3,000
Hot water generator combustion efficiency	--	1,200
Gauges and dials	--	4,000
Total		$33,500

This assumes that no additional manpower will be required by EMCS personnel, nor will there be any reduction of personnel in the plant to operate the valves. However, the change that will take place will be the EMCS personnel will actually have either physical control or the ability to tell people in the Plant to change valve positions or start equipment.

ECO METHODOLOGY FORM

ECO NAME: EMCS Controls of Boiler and Chiller vs. Manual Control (Cont'd)

ECO NUMBER: 89

TYPE: BLDG Bldg. 25330

SYSTEM: Heating

CALCULATION & COST METHODOLOGY:

Gas consumption used in Building 25330 is 90,517 mcf. A 3% overall efficiency improvement is based on the fact that there will be better regulation of HTW temperatures. The hot water generator firing rate can be adjusted for predicting of loads which the EMCS people will monitor and record, and also pumping speed regulation will be controlled by EMCS so that all buildings will be adequately served to get the required amount of HTW with a minimum amount of pumping energy used. Another savings would be the combustion controls regulations so that by monitoring the air flows and the oxygen in the flue gases some regulation of the combustion of the new hot water generators will be available to be made by EMCS people either directly or by calling in the operator that is available in the Plant.

Calculation is:

$$\frac{.03 \times 90{,}517 \text{ mcf} \times 1{,}030{,}000 \text{ Btu's/mcf}}{10^6 \text{ Btu's/Million Btu's}} = 2{,}796.98 \text{ Million Btu's/yr.}$$

CONSTRUCTION COST ESTIMATE	DATE: 23 SEPT 94	SHEET 1 OF 1
Project: FORT GORDON ENERGY STUDY		
Location: AUGUSTA, GEORGIA	PROJ. NO. 4	
Arch/Engr: HARRISON AND SPENCER, INC.	CODE: BLDG 25330	
Summary: ECO #89 - EMCS - HTW SOUTH	Estimator: H. TOUB	Checked:

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
FUEL FLOW	1	LS	4000	4000	2000	2000	$6,000.00
EXPANSION TANK	1	LS	1400	1400	600	600	$2,000.00
HTW PIPING	1	LS	2300	2300	2700	2700	$5,000.00
MAKE-UP WATER	1	LS	2000	2000	1500	1500	$3,500.00
NITROGEN	1	LS	1000	1000	1500	1500	$2,500.00
VALVE POSTIONS	1	LS	700	700	1300	1300	$2,000.00
BTU COMPUTATIONS	1	LS	500	500	2000	2000	$2,500.00
CHEMICAL FEED	1	LS	900	900	900	900	$1,800.00
HW GENERATOR PUMPS CONTOLS	1	LS	2000	2000	1000	1000	$3,000.00
HW GENERATOR COMBUSTION EFFICIENCY	1	LS	600	600	600	600	$1,200.00
GAUGES & DIALS	1	LS	2000	2000	2000	2000	$4,000.00
	SUBTOTAL			17400		16100	
	5% SALES TAX			$870.00			
	17% LABOR TAX					$2,737.00	
	SUBTOTALS			$18,270.00		$18,837.00	$37,107.00
	20% OH (GC ONLY)						$7,421.40
	SUBTOTAL GC'S WORK						$44,528.40
	SUBTOTAL(GC & SUBS)						$44,528.40
	10% GC'S PROFIT						
	5% CONTINGENCY						$2,226.42
	TOTAL						**$46,754.82**

HEATING REQUIREMENTS DATA SUMMARY - BUILDING 25330

INTRODUCTION:

Heat load requirements for the South Central Utility Plant were determined from field survey data. The data analyzed using the Trane Trace 600 Load calculation program. The data reported in Tables 4A, 4B, and 3C are the results of the analysis. The data files produced from the Trace 600 program are contained in Appendix I Load calculations were run for the 36 building types that represent all the building types serviced by the South Central Plant. These building types represent 86 total buildings serviced on the south side of the base from Building 25330. The following commentary explains the data contained in each of the tables.

Table 4A - Heating Profile - Building Types Serviced By South Central Utility Plant - Building 25330

Each building type (36 total), as defined in the field survey, is listed across the top of the table. Values are recorded for every hour for twenty four hours. There are twelve sections to the table, one for each month of the year. Each entry is in thousands of BTU/hr. Table 4A therefore contains heating requirements for each building type for every hour of the day for all twelve months of the year in thousands of BTU's per Hour (MBTUH). The last column on the right contains the total MBTUH values for each building type for a particular hour. The data shows that the loads are highest during the winter months of December, January, and February. As you proceed into spring, loads diminish and the hours requiring heat become less. As you proceed into the summer months you may see some small loads reported. Keeping in mind that we are reporting loads in thousands of BTU's, the values are very small and are dropped in later calculations.

Table 4B - Heating Profile - Total of All Buildings Serviced By South Central Utility Plant - Building 25330

Some of the building types surveyed are representative of multiple buildings of the same type. Table 4B accounts for multiple buildings by building type. The totals column therefore is representative of the true hourly loads for each month. Building types representing more than one building are: Type 31-5 buildings, Type 31A-2 buildings, Type 33-5 buildings, Type 35-6 buildings, Type 36-15 buildings, Type 37-2 buildings, Type 38-2 buildings, Type 41-2 buildings, and Type 44-8 buildings. All the rest of the building types represent a single building each. There are a total of 53 buildings serviced by the Central utility Plant Building 25330.

Table 4C - Heat Load Requirement Summary - South Utility Plant Building 25330

This table is a compilation of the totals column taken from Table 4B for each month. This Table provides a means to estimate plant heating load requirements on the hot water generating equipment at the South Plant.

SUMMARY:

All the data recorded in Table 4 (A, B & C) was derived from field survey information and the Trace 600 load calculations. See Appendix II for a complete printout of all generated data for buildings serviced by the South Utility Plant. The values appearing in Table 4A were taken directly from the Trace output data in Appendix II.

HEATING PROFILE - BUILDING SERVICED BY SOUTH CENTRAL UTILITY PLANT - BUILDING 25330

JANUARY

DAY HOUR	BUILDING TYPE														
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	263	298	58	22	142	87	180	195	76	77	82	101	113	64	41	1799
2	267	301	61	22	140	89	184	199	81	78	84	104	115	65	42	1832
3	267	301	62	22	142	93	190	201	85	77	86	108	116	66	42	1858
4	264	299	61	21	136	93	186	197	88	75	88	108	114	66	41	1837
5	260	295	59	20	128	96	191	197	91	72	88	109	114	67	41	1828
6	254	289	55	19	115	95	190	194	90	68	89	109	112	68	40	1787
7	247	283	50	18	99	95	186	185	88	63	89	107	108	66	38	1722
8	235	274	45	16	80	93	179	180	87	58	88	104	102	66	36	1643
9	210	264	34	15	52	84	157	159	78	53	87	88	89	57	32	1459
10	194	220	23	13	36	78	142	142	69	48	85	72	75	52	30	1279
11	172	201	10	11	34	72	127	122	51	42	83	53	56	47	26	1107
12	165	192	1	9	28	69	120	111	35	37	79	42	44	43	24	999
13	155	180		7	22	64	111	100	19	32	74	32	32	41	21	890
14	145	169		6	18	57	101	90	8	28	70	23	24	36	19	794
15	132	154		6	17	52	85	82		25	65	17	19	34	18	706
16	123	144		5	15	44	71	78		24	61	14	17	32	18	646
17	124	144		6	16	41	65	79		25	59	18	24	34	19	654
18	138	160		7	18	43	74	93		29	57	33	37	35	21	745
19	155	179		9	21	45	85	109	5	36	58	45	49	36	24	856
20	178	206		12	26	51	98	125	26	44	61	56	61	40	27	1011
21	195	226		15	31	58	117	140	36	52	64	66	74	45	30	1149
22	218	252	1	17	36	66	137	159	49	60	69	76	86	51	34	1311
23	236	272	44	19	39	73	149	171	58	68	73	84	96	55	37	1474
24	253	292	52	21	42	80	165	184	69	73	78	93	105	61	39	1607

FEBRUARY

DAY HOUR	BUILDING TYPE														
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	213	246	25	16	36	70	139	156	60	59	71	81	89	51	33	1345
2	227	262	40	17	38	75	153	167	66	63	75	87	96	55	35	1456
3	241	273	46	19	40	80	164	176	72	68	79	94	102	59	37	1550
4	247	285	51	20	98	85	170	184	78	71	82	99	107	60	39	1676
5	260	292	56	21	124	91	185	193	84	74	86	104	115	64	41	1790
6	262	296	58	21	131	93	189	198	88	75	88	108	116	66	41	1830
7	263	298	61	21	136	96	196	203	92	76	91	112	119	69	42	1875
8	261	297	59	21	132	96	190	200	95	74	93	111	117	67	42	1855
9	235	291	50	20	112	89	170	180	88	71	93	95	105	60	39	1698
10	219	256	39	18	87	85	158	162	78	65	93	78	92	57	36	1523
11	205	239	27	15	56	83	148	148	63	58	91	64	77	54	33	1361
12	191	223	17	12	38	80	140	134	48	50	88	52	62	50	30	1215
13	178	202	5	10	35	72	130	116	30	42	82	39	42	44	26	1053
14	160	186		8	26	64	114	102	15	34	76	29	31	40	23	908
15	139	162		6	21	56	93	85	3	29	71	18	21	36	20	760
16	124	145		5	19	49	80	78		25	66	16	21	35	19	682
17	117	137		5	17	43	63	76		24	62	16	26	34	18	638
18	118	138		5	18	40	57	79	5	25	59	22	32	34	19	651
19	137	159		6	19	42	71	96	13	28	58	37	44	35	21	766
20	151	175		8	23	46	81	105	22	32	59	47	53	38	23	863
21	163	189		9	25	50	91	114	31	37	60	55	59	40	25	6448
22	176	204		11	28	54	105	126	40	42	63	61	66	43	27	1046
23	186	216		13	30	59	116	134	45	48	65	67	74	46	29	1128
24	201	233		14	33	63	127	145	52	53	68	73	81	48		1191

Table 4A - 1

MARCH

DAY HOUR	BUILDING TYPE 31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	120	139		5	23	34	69	91		32	37	44	54	24	21	693
2	137	158		8	25	42	87	104		38	41	52	63	29	24	798
3	150	169		10	29	48	100	117	24	44	46	60	69	33	26	925
4	159	184		11	31	53	113	127	51	48	49	66	75	36	28	1031
5	169	190		12	33	58	120	133	56	50	52	70	79	39	29	1090
6	172	199		13	34	61	127	139	60	51	56	74	83	42	30	1141
7	170	196		13	33	62	129	139	61	50	57	76	82	42	30	1140
8	149	172		12	32	56	112	122	62	47	58	67	75	35	27	1036
9	125	146		10	30	51	91	101	55	41	58	49	64	30	23	874
10	102	115		7	24	44	71	75	45	34	55	30	48	24	19	693
11	72	85		4	19	36	47	48	25	25	51	10	26	16	15	479
12	52	62		1	12	28	33	30	3	16	45	2	5	11	10	310
13	39	47			7	23	26	16		7	39			7	6	217
14	18	22			3	13	5				31			1	3	96
15	5	8				6					24				1	44
16											7					7
17											2					2
18											2					2
19											2				1	3
20											11	2			6	19
21	32	44									20				9	105
22	66	77			5			31		7	26			1	12	225
23	85	98			15	8		61		16	29	5		15	15	347
24	106	118		2	19	27		78		24	33	17	30	21	18	493

APRIL

DAY HOUR	BUILDING TYPE 31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1						1										1
2															5	5
3															13	13
4										6		16	9		15	46
5					12			38		12		37	43		16	158
6					20			76		17		41	46		18	218
7					20			72	31	19		40	47		17	246
8	33				19		11	60	34	19		28	42		15	261
9	48	32			16	18	33	41	29	15		12	33		12	289
10	10	13			10	11		8	17	8	4	2	15		7	105
11					4	2					2				2	10
12																0
13																0
14																0
15																0
16																0
17																0
18																0
19																0
20																0
21		16														16
22	8	10														18
23	24	29										3				56
24	2	3				5	12									22

Table 4A - 2

MAY

DAY HOUR	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
	BUILDING TYPE															
1												1				1
2	11	13														24
3	27	32				2	11									72
4	41	42				9										92
5	4	4										7				15
6												18			11	29
7												13			9	22
8												3			7	10
9															3	3
10																0
11																0
12																0
13																0
14																0
15																0
16																0
17																0
18																0
19																0
20																0
21																0
22																0
23																0
24												4				4

JUNE

DAY HOUR	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
	BUILDING TYPE															
1																0
2																0
3																0
4																0
5																0
6																0
7																0
8																0
9																0
10																0
11																0
12																0
13																0
14																0
15																0
16																0
17																0
18																0
19																0
20																0
21																0
22																0
23																0
24																0

Table 4A - 3

JULY

DAY HOUR	BUILDING 31	31A	32	33	34	35	36	TYPE 37	38	39	40	41	42	43	44	TOTAL
1																0
2																0
3																0
4																0
5																0
6																0
7																0
8																0
9																0
10																0
11																0
12																0
13																0
14																0
15																0
16																0
17																0
18																0
19																0
20																0
21																0
22																0
23																0
24																0

AUGUST

DAY HOUR	BUILDING 31	31A	32	33	34	35	36	TYPE 37	38	39	40	41	42	43	44	TOTAL
1																0
2																0
3																0
4																0
5																0
6																0
7																0
8																0
9																0
10																0
11																0
12																0
13																0
14																0
15																0
16																0
17																0
18																0
19																0
20																0
21																0
22																0
23																0
24																0

Table 4A - 4

SEPTEMBER

DAY HOUR	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1																0
2	7	8														15
3	22	21				2	8									53
4	30	34				8										72
5	3	3														6
6												12			1	13
7												14			9	23
8												3			6	9
9															3	3
10																0
11																0
12																0
13																0
14																0
15																0
16																0
17																0
18																0
19																0
20																0
21																0
22																0
23																0
24																0

OCTOBER

DAY HOUR	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	103	119		4	20	18		79		27	30	29	3		18	450
2	118	131		6	22	33	56	92		32	32	45	52		21	640
3	126	145		8	24	39	84	100		37	38	52	58	24	23	758
4	138	154		9	27	44	93	110	23	41	41	57	63	27	25	852
5	143	165		10	28	50	105	116	47	43	45	63	68	30	26	939
6	153	176		11	30	54	114	123	52	44	48	67	72	34	27	1005
7	149	172		10	30	55	116	121	52	42	49	68	71	34	26	995
8	128	144		9	29	50	96	105	50	38	49	58	62	28	23	869
9	97	113		6	24	41	71	79	40	30	47	37	45	20	19	669
10	68	80		3	18	35	51	52	24	20	44	17	25	15	14	466
11	44	48			11	24	30	27	1	9	39		1	6	9	249
12	19	23			4	17	15	5			32				4	119
13	6	8				10					24					48
14						1					18					19
15																0
16																0
17																0
18																0
19																0
20												5				5
21											6	1			8	15
22	29	40								5	20				11	105
23	75	87			9			39		13	24				14	261
24	87	101		2	16			67		21	27	2			16	339

Table 4A – 5

NOVEMBER

DAY HOUR	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
	BUILDING TYPE															
1	116	133		7	20	32	69	87		32	34	42	46	22	20	660
2	132	152		9	23	39	84	99		38	38	50	56	27	22	769
3	146	169		10	27	44	98	113		44	42	57	64	30	25	869
4	160	179		12	29	51	107	123	38	48	46	63	70	34	27	2887
5	166	191		13	30	56	118	130	52	51	50	69	75	37	28	1066
6	175	202		14	23	60	125	137	57	53	53	74	79	40	30	1122
7	178	205		14	34	64	130	142	61	54	56	77	82	42	31	1170
8	172	198		13	33	64	129	137	60	52	58	76	80	42	30	1144
9	147	171		12	32	56	107	118	53	46	58	60	65	35	26	986
10	120	140		9	27	50	88	93	37	37	56	38	45	29	22	791
11	101	118		5	20	44	75	70	19	25	51	19	24	23	17	611
12	80	88		1	14	38	62	49		13	45	5	3	19	12	429
13	55	65			7	31	46	31		2	38			13	8	296
14	30	36			2	18	23	11			31			6	4	161
15	6	14				7					24			1	1	53
16											19					19
17											13				1	14
18	9	15									7			1	3	35
19	30	36				1		2			12			3	5	89
20	44	52				5		30			17			7	7	162
21	58	67			5	10		39		1	20			8	9	217
22	76	88			11	16	3	52		10	24			13	12	305
23	87	101		2	14	21	43	61		17	26	3		16	14	405
24	104	121		4	17	27	56	75		25	30	23		20	17	519

DECEMBER

DAY HOUR	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
	BUILDING TYPE															
1	179	207		14	30	58	119	132	45	51	55	67	74	42	29	1102
2	193	223		15	34	63	130	143	54	55	59	74	81	45	31	1200
3	203	229		16	35	68	140	149	60	58	62	80	86	47	32	1265
4	208	239		17	36	71	146	157	65	61	65	83	90	50	33	1321
5	210	243	4	17	38	74	152	162	69	62	68	88	93	52	34	1366
6	217	245	42	17	63	76	158	164	71	62	71	90	96	54	34	1460
7	217	251	41	17	80	79	163	166	74	60	72	93	97	55	35	1500
8	211	239	38	15	67	79	160	163	76	56	73	91	95	56	34	1453
9	183	212	27	13	35	71	136	142	67	50	72	77	79	48	30	1242
10	161	182	12	11	31	65	116	119	51	42	70	58	60	42	26	1046
11	137	160		8	25	58	100	97	33	33	66	39	38	35	22	851
12	118	138		5	20	51	87	79	13	25	61	21	20	30	18	686
13	104	122		3	14	47	78	65		17	56	11	5	26	14	562
14	93	108		1	11	39	62	53		12	51	4		22	12	468
15	79	93		1	9	32	50	48		10	47			20	11	400
16	71	83		1	8	26	34	42		11	43			19	11	349
17	75	88		2	9	24	32	49		12	41			19	12	363
18	91	106		3	10	26	42	62		15	39	9		21	14	438
19	105	121		4	13	27	51	73		20	40	27	26	23	16	546
20	118	136		6	17	31	60	83		25	41	34	36	26	18	631
21	128	148		8	20	36	71	93		30	43	41	43	27	20	708
22	144	167		9	22	40	83	101		36	45	48	52	32	22	801
23	156	180		11	26	46	95	113		41	48	55	60	35	25	891
24	169	195		12	28	52	105	122	35	46	52	61	67	38	27	974

Table 4A - 6

HEATING PROFILE - BUILDING SERVICED BY SOUTH CENTRAL UTILITY PLANT - BUILDING 25330

JANUARY

DAY HOUR	BUILDING TYPE														
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	1315	596	58	110	142	522	2700	390	152	77	82	202	113	64	328	6851
2	1335	602	61	110	140	445	2760	398	162	78	84	208	115	65	336	6899
3	1335	602	62	110	142	465	2850	402	170	77	86	216	116	66	336	7035
4	1320	598	61	105	136	465	2790	394	176	75	88	216	114	66	328	6932
5	1300	590	59	100	128	480	2865	394	182	72	88	218	114	67	328	6985
6	1270	578	55	95	115	475	2850	388	180	68	89	218	112	68	320	6881
7	1235	566	50	90	99	475	2790	370	176	63	89	214	108	66	304	6695
8	1175	548	45	80	80	465	2685	360	174	58	88	208	102	66	288	6422
9	1050	528	34	75	52	420	2355	318	156	53	87	176	89	57	256	5706
10	970	440	23	65	36	390	2130	284	138	48	85	144	75	52	240	5120
11	860	402	10	55	34	360	1905	244	102	42	83	106	56	47	208	4514
12	825	384	1	45	28	345	1800	222	70	37	79	84	44	43	192	4199
13	775	360		35	22	320	1665	200	38	32	74	64	32	41	168	3826
14	725	338		30	18	285	1515	180	16	28	70	46	24	36	152	3463
15	660	308		30	17	260	1275	164		25	65	34	19	34	144	3035
16	615	288		25	15	220	1065	156		24	61	28	17	32	144	2690
17	620	288		30	16	205	975	158		25	59	36	24	34	152	2622
18	690	320		35	18	215	1110	186		29	57	66	37	35	168	2966
19	775	358		45	21	225	1275	218	10	36	58	90	49	36	192	3388
20	890	412		60	26	255	1470	250	52	44	61	112	61	40	216	3949
21	975	452		75	31	290	1755	280	72	52	64	132	74	45	240	4537
22	1090	504	1	85	36	330	2055	318	98	60	69	152	86	51	272	5207
23	1180	544	44	95	39	365	2235	342	116	68	73	168	96	55	296	5716
24	1265	584	52	105	42	400	2475	368	138	73	78	186	105	61.00	312	6244

FEBRUARY

DAY HOUR	BUILDING TYPE														
	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	1065	492	25	80	36	350	2085	312	120	59	71	162	89	51	264	5261
2	1135	524	40	85	38	375	2295	334	132	63	75	174	96	55	280	5701
3	1205	546	46	95	40	400	2460	352	144	68	79	188	102	59	296	6080
4	1235	570	51	100	98	425	2550	368	156	71	82	198	107	60	312	6383
5	1300	584	56	105	124	455	2775	386	168	74	86	208	115	64	328	6828
6	1310	592	58	105	131	465	2835	396	176	75	88	216	116	66	328	6957
7	1315	596	61	105	136	480	2940	406	184	76	91	224	119	69	336	7138
8	1305	594	59	105	132	480	2850	400	190	74	93	222	117	67	336	7024
9	1175	582	50	100	112	445	2550	360	176	71	93	190	105	60	312	6381
10	1095	512	39	90	87	425	2370	324	156	65	93	156	92	57	288	5849
11	1025	478	27	75	56	415	2220	296	126	58	91	128	77	54	264	5390
12	955	446	17	60	38	400	2100	268	96	50	88	104	62	50	240	4974
13	890	404	5	50	35	360	1950	232	60	42	82	78	42	44	208	4482
14	800	372		40	26	320	1710	204	30	34	76	58	31	40	184	3925
15	695	324		30	21	280	1395	170	6	29	71	36	21	36	160	3274
16	620	290		25	19	245	1200	156		25	66	32	21	35	152	2886
17	585	274		25	17	215	945	152		24	62	32	26	34	144	2535
18	590	276		25	18	200	855	158	10	25	59	44	32	34	152	2478
19	685	318		30	19	210	1065	192	26	28	58	74	44	35	168	2952
20	755	350		40	23	230	1215	210	44	32	59	94	53	38	184	3327
21	815	378		45	25	250	1365	228	62	37	60	110	5559	40	200	9174
22	880	408		55	28	270	1575	252	80	42	63	122	66	43	216	4100
23	930	432		65	30	295	1740	268	90	48	65	134	74	46	232	4449
24	1005	466		70	33	315	1905	290	104	53	68	146	81	48		4584

Table 4B – 1

MARCH

DAY HOUR	BUILDING TYPE 31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	600	278		25	23	170	1035	182		32	37	88	54	24	168	2716
2	685	316		40	25	210	1305	208		38	41	104	63	29	192	3236
3	750	338		50	29	240	1500	234	48	44	46	120	69	33	208	3709
4	795	368		55	31	265	1695	254	102	48	49	132	75	36	224	4129
5	845	380		60	33	290	1800	266	112	50	52	140	79	39	232	4378
6	860	398		65	34	305	1905	278	120	51	56	148	83	42	240	4585
7	850	392		65	33	310	1935	278	122	50	57	152	82	42	240	4608
8	795	344		60	32	280	1680	244	124	47	58	134	75	35	216	4124
9	625	292		50	30	255	1365	202	110	41	58	98	64	30	184	3404
10	510	230		35	24	220	1065	150	90	34	55	60	48	24	152	2697
11	360	170		20	19	180	705	98	50	25	51	20	26	16	120	1858
12	260	124		5	12	140	495	60	6	16	45	4	5	11	80	1263
13	195	94			7	115	390	32		7	39			7	48	934
14	90	44			3	65	75				31			1	24	333
15	25	16				30					24				8	103
16											7					7
17											2					2
18											2					2
19											2				8	10
20											11	4			48	63
21	160	88									20				72	340
22	330	154			5			62		7	26			1	96	681
23	425	196			15	40		122		16	29	10		15	120	988
24	530	236		10	19	135		156		24	33	34	30	21	144	1372

APRIL

DAY HOUR	BUILDING TYPE 31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1						5										5
2															40	40
3															104	104
4										6		32	9		120	167
5					12			76		12		74	43		128	345
6					20			152		17		82	46		144	461
7					20			144	62	19		80	47		136	508
8	165				19		165	120	68	19		56	42		120	774
9	240	64			16	90	495	82	58	15		24	33		96	1213
10	50	26			10	55		16	34	8	4	4	15		56	278
11					4	10					2				16	32
12																0
13																0
14																0
15																0
16																0
17																0
18																0
19																0
20		32														32
21	40	20														60
22	120	58										6				184
23	10	6				25	180									221
24																

Table 4B - 2

MAY

DAY HOUR	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
	BUILDING TYPE															
1												2				2
2	55	26														81
3	135	64				10	165									374
4	205	84				45										334
5	20	8										14				42
6												36			88	124
7												26			72	98
8												6			56	62
9															24	24
10																0
11																0
12																0
13																0
14																0
15																0
16																0
17																0
18																0
19																0
20																0
21																0
22																0
23																0
24												8				8

JUNE

DAY HOUR	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
	BUILDING TYPE															
1																0
2																0
3																0
4																0
5																0
6																0
7																0
8																0
9																0
10																0
11																0
12																0
13																0
14																0
15																0
16																0
17																0
18																0
19																0
20																0
21																0
22																0
23																0
24																0

Table 4B - 3

JULY

DAY HOUR	BUILDING TYPE 31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1																0
2																0
3																0
4																0
5																0
6																0
7																0
8																0
9																0
10																0
11																0
12																0
13																0
14																0
15																0
16																0
17																0
18																0
19																0
20																0
21																0
22																0
23																0
24																0

AUGUST

DAY HOUR	BUILDING TYPE 31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1																0
2																0
3																0
4																0
5																0
6																0
7																0
8																0
9																0
10																0
11																0
12																0
13																0
14																0
15																0
16																0
17																0
18																0
19																0
20																0
21																0
22																0
23																0
24																0

Table 4B - 4

SEPTEMBER

DAY HOUR	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
	BUILDING TYPE															
1																0
2	35	16														51
3	110	42				2	120									274
4	150	68				8										226
5	15	6														21
6												24			8	32
7												28			72	100
8												6			48	54
9															24	24
10																0
11																0
12																0
13																0
14																0
15																0
16																0
17																0
18																0
19																0
20																0
21																0
22																0
23																0
24																0

OCTOBER

DAY HOUR	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
	BUILDING TYPE															
1	515	238		20	20	90		158		27	30	58	3		144	1303
2	590	262		30	22	165	840	184		32	32	90	52		168	2467
3	630	290		40	24	195	1260	200		37	38	104	58	24	184	3084
4	690	308		45	27	220	1395	220	46	41	41	114	63	27	200	3437
5	715	330		50	28	250	1575	232	94	43	45	126	68	30	208	3794
6	765	352		55	30	270	1710	246	104	44	48	134	72	34	216	4080
7	745	344		50	30	275	1740	242	104	42	49	136	71	34	208	4070
8	640	288		45	29	250	1440	210	100	38	49	116	62	28	184	3479
9	485	226		30	24	205	1065	158	80	30	47	74	45	20	152	2641
10	340	160		15	18	175	765	104	48	20	44	34	25	15	112	1875
11	220	96			11	120	450	54	2	9	39		1	6	72	1080
12	95	46			4	85	225	10			32				32	529
13	30	16				50					24					120
14						5					18					23
15																0
16																0
17																0
18																0
19																0
20												10				10
21											6	2			64	72
22	145	80								5	20				88	338
23	375	174			9			78		13	24				112	785
24	435	202		10	16			134		21	27	4			128	977

Table 4B - 5

NOVEMBER

DAY HOUR	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	580	266		35	20	160	1035	174		32	34	84	46	22	160	2648
2	660	304		45	23	195	1260	198		38	38	100	56	27	176	3120
3	730	338		50	27	220	1470	226		44	42	114	64	30	200	3555
4	800	358		60	29	255	1605	246	78	48	46	126	70	34	216	11669
5	830	382		65	30	280	1770	260	104	51	50	138	75	37	224	4296
6	875	404		70	23	300	1875	274	114	53	53	148	79	40	240	4548
7	890	410		70	34	320	1950	284	122	54	56	154	82	42	248	4716
8	860	396		65	33	320	1935	274	120	52	58	152	80	42	240	4627
9	735	342		60	32	280	1605	236	106	46	58	120	65	35	208	3928
10	600	280		45	27	250	1320	186	74	37	56	76	45	29	176	3201
11	505	236		25	20	220	1125	140	38	25	51	38	24	23	136	2606
12	400	176		5	14	190	930	98		13	45	10	3	19	96	1999
13	275	130			7	155	690	62		2	38			13	64	1436
14	150	72			2	90	345	22			31			6	32	750
15	30	28				35					24			1	8	126
16											19					19
17											13				8	21
18	45	30									7			1	24	107
19	150	72				5		4			12			3	40	286
20	220	104				25		60			17			7	56	489
21	290	134			5	50		78		1	20			8	72	658
22	380	176			11	80	45	104		10	24			13	96	939
23	435	202		10	14	105	645	122		17	26	6		16	112	1710
24	520	242		20	17	135	840	150		25	30	46		20	136	2181

BUILDING TYPE

DECEMBER

DAY HOUR	31	31A	32	33	34	35	36	37	38	39	40	41	42	43	44	TOTAL
1	895	414		70	30	290	1785	264	90	51	55	134	74	42	232	4426
2	965	446		75	34	315	1950	286	108	55	59	148	81	45	248	4815
3	1015	458		80	35	340	2100	298	120	58	62	160	86	47	256	5115
4	1040	478		85	36	355	2190	314	130	61	65	166	90	50	264	5324
5	1050	486	4	85	38	370	2280	324	138	62	68	176	93	52	272	5498
6	1085	490	42	85	63	380	2370	328	142	62	71	180	96	54	272	5720
7	1085	502	41	85	80	395	2445	332	148	60	72	186	97	55	280	5863
8	1055	478	38	75	67	395	2400	326	152	56	73	182	95	56	272	5720
9	915	424	27	65	35	355	2040	284	134	50	72	154	79	48	240	4922
10	805	364	12	55	31	325	1740	238	102	42	70	116	60	42	208	4210
11	685	320		40	25	290	1500	194	66	33	66	78	38	35	176	3546
12	590	276		25	20	255	1305	158	26	25	61	42	20	30	144	2977
13	520	244		15	14	235	1170	130		17	56	22	5	26	112	2566
14	465	216		5	11	195	930	106		12	51	8		22	96	2117
15	395	186		5	9	160	750	96		10	47			20	88	1766
16	355	166		5	8	130	510	84		11	43			19	88	1419
17	375	176		10	9	120	480	98		12	41			19	96	1436
18	455	212		15	10	130	630	124		15	39	18		21	112	1781
19	525	242		20	13	135	765	146		20	40	54	26	23	128	2137
20	590	272		30	17	155	900	166		25	41	68	36	26	144	2470
21	640	296		40	20	180	1065	186		30	43	82	43	27	160	2812
22	720	334		45	22	200	1245	202		36	45	96	52	32	176	3205
23	780	360		55	26	230	1425	226		41	48	110	60	35	200	3596
24	845	390		60	28	260	1575	244	70	46	52	122	67	38	216	3943

BUILDING TYPE

Table 4B – 6

TONNAGE PROFILE BY MONTH - BUILDINGS SERVICED BY SOUTH CENTRAL UTILITY PLANT - BUILDING 25330

DAY HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	6851	5261	2716	5	2	0	0	0	0	1303	2648	4426
2	6899	5701	3236	40	81	0	0	0	51	2467	3120	4815
3	7035	6080	3709	104	374	0	0	0	274	3084	3555	5115
4	6932	6383	4129	167	334	0	0	0	226	3437	11669	5324
5	6985	6828	4378	345	42	0	0	0	21	3794	4296	5498
6	6881	6957	4585	461	124	0	0	0	32	4080	4548	5720
7	6695	7138	4608	508	98	0	0	0	100	4070	4716	5863
8	6422	7024	4124	774	62	0	0	0	54	3479	4627	5720
9	5706	6381	3404	1213	24	0	0	0	24	2641	3928	4922
10	5120	5849	2697	278	0	0	0	0	0	1875	3201	4210
11	4514	5390	1858	32	0	0	0	0	0	1080	2606	3546
12	4199	4974	1263	0	0	0	0	0	0	529	1999	2977
13	3826	4482	934	0	0	0	0	0	0	120	1436	2566
14	3463	3925	333	0	0	0	0	0	0	23	750	2117
15	3035	3274	103	0	0	0	0	0	0	0	126	1766
16	2690	2886	7	0	0	0	0	0	0	0	19	1419
17	2622	2535	2	0	0	0	0	0	0	0	21	1436
18	2966	2478	2	0	0	0	0	0	0	0	107	1781
19	3388	2952	10	0	0	0	0	0	0	0	286	2137
20	3949	3327	63	0	0	0	0	0	0	10	489	2470
21	4537	9174	340	32	0	0	0	0	0	72	658	2812
22	5207	4100	681	60	0	0	0	0	0	338	939	3205
23	5716	4449	988	184	0	0	0	0	0	785	1710	3596
24	6244	4584	1372	221	8	0	0	0	0	977	2181	3943

Table 4C

ROWLAND
01!Fort Gordon
P1CARLTON SHUFORD
P2DSN 780-6376
P3ATZH-DIC-E
/RECALL F 000045556 S 03 ECIP PROJECT 4: UPGRADE HIGH TEMPERATURE WATER SOUTH BUILDING 25330, FT. GORDON

03A !DESCRIPTION OF PROPOSED CONSTRUCTION

***The concept of the heating plant as a steam generating boiler plant which sparges steam into the high temperature water, and is then pumped through the underground pipe distribution has changed completely. The new concept is to replace the steam boilers with hot water generators operating in an auxiliary loop circulating HTW water system from and to the three existing cascade heaters that will be converted for use as expansion/storage tanks. Those tanks will now be pressurized with nitrogen and the pressure on the tank will vary as the water level increases or decreases. The water level will change based on the variable speed pumping and losses in the system. The existing deaerator needs to be modified before any other work is done. The deaerator vessel and storage tank are hopefully reusable, but is our suspicion that the trays within the deaerator are not operating or need to be replace entirely. Another item that needs to be done prior to making the switch over from steam to hot water is to add chemical feed tanks and have chemicals feed at the appropriate locations. This should be done in coordination with the chemical supplier, but basically we are adding sulfite and PH control to the make-up water in the deaerator or immediately after the deaerator. Then there is an additional chemical that needs to be added to the distribution system to make sure that the oxygen corrosion is not an additional problem, and that exposed piping does not corrode. The distribution piping shall also be protected from oxygen pitting and PH imbalance when the make-up water requirement is reduced.

Because there is a multiplicity of units available to be converted and to be replaced with new, it is possible that the steam can remain in operation while the new hot water generators are added and one or more of the cascade heaters is converted so that the plant can serve the needs of the distribution system during the construction period. Then there will be a small shutdown period where you convert over to hot water generation from steam generation. If this can be coordinated with the summer shutdown so that all of the work in the buildings is completed to generate domestic water, then the HTW system can be shutdown 4-1/2 months of the summer to make this conversion from steam to hot water generation.

03B !REMARKS

***Data for this analysis was based on assumed existing efficiency of the boilers of 70%. This was in lieu of not having any accurate information on the efficiencies of the boilers. Recent articles in the ASHRAE Journal and elsewhere indicates that for the Plant as it is now, 70% is probably a very high efficiency for the actual conditions. Even with this payback indicated, we can expect a better payback if the projects are implemented. There are also opportunities to increase the savings if higher efficiency equipment is installed in the buildings. We assumed 80% efficiency for gas combustion, but there are gas-fired heaters that can get into the 90's. This costs additional money, but they may be worthwhile on the basis of dollars they save when the current natural gas prices are compared with high efficiency water heating equipment prices.

The energy conservation measure to upgrade the Heating Plant in Building 25910 includes seven ECO's developed during the extensive engineering study that was conducted. The following describes the ECO's that are included in this ECIP.

ECO NO.	DESCRIPTION
26	Variable Speed Hot Water Pumping System
28	Return Hot Water Temperature Control
32	Reduce Make-up Hot Water
68	Hot Water Generators System
70	HTW System
72	Reduce Steam Leaks
89	EMCS Controls and Instrumentation

ECO DATA COMPILATION

ECO NO.	DESCRIPTION	COST (FROM LCC)	SAVINGS 1ST YEAR	TOTAL DISCOUNT SAVINGS
26	Variable Speed Pumping	26,738	5,771	90,086
28	Return Hot Water Temp. Control	54,160	14,403	296,079
32	Reduce Make-up Water	51,209	14,351	294,814
68	Hot Water Generators	774,748	30,977	587,085
70c	Summer Shutdown (1/2 gas, 1/2 hp)	272,389	157,426	2,760,665
72	Reduce Steam Leaks	1,439	897	18,797
89	EMCS Controls & Instrumentation	52,133	12,586	263,811
	Totals	1,232,816	236,312	4,311,334

Simple Payback: $\frac{1{,}232{,}816}{236{,}312} = 5.22$

SIR: $\frac{4{,}311{,}334}{1{,}163{,}554} = 3.50$

03C !PROJECT DESCRIPTION

***This Energy conservation measure provides the plan to design the required conservation and upgrade to the heating system in building 25910 - Central Utility Plant - North. The scope of this effort includes addition of two new variable speed pumps, additional control for hot water return temperature regulation, reduction of make-up water required and replacement of five low efficiency steam boilers with three hot water generators. In addition the piping distribution system will be redesigned into three distribution systems and hot water/steam leaks will be reduced or eliminated.

To maximize energy savings, new EMCS controls will be added to permit control of the HTW system from

the Energy Management Control System. This system will permit optimization of how water temperature set point, time of day scheduling and summer shut down of the system. This function will support minimizing staffing requirements.

03D !REQUIREMENT (Why is it needed now)

****The existing steam heating plant is antequated and inefficient. The study showed that the boilers are operating at about 70% efficiency, large quantities of make-up water is required to overcome leaks in the existing system. Recent building renovations to the hot water systems in the Barracks, classrooms and administrative office have increased demand for heating capacity.

By implementing the energy conservation improvement now, annual savings of $354,008 can be realized, reducing the cost of operation for the entire facility.

03E !CURRENT SITUATION (How is the need currently being met)

***ECO 26

HTW water leaving Building 25330 is pumped with only one set of two identical pumps. The pumps are Ingersol-Rand 4 x 9A with a Louis Allis motor with a serial number of 5111871001 on one motor, and 5111871002 on the other. Type C004NB, 460 volts, 1.15 service factor, 4040 TS frame and the rating is 100 hp at 3550 rpm or 25 hp at 1776 rpm. One or the other of these pumps always operate at low speed. All buildings in the distribution system are equipped with 2-way valves so that when HTW is not required, the flow ceases to that building. Just upstream of the pump there is a blending station that mixes hot water return water before it gets heated with the heated HTW to control the temperature of the HTW leaving the Plant.

ECO 28

HTW is heated in cascade heaters, which is usually maintained at the temperature of the saturation pressure of the boiler, and this boiler pressure is usually maintained except for several times a year when it is changed. At 150 psi, the saturation temperature is 347°F. When the HTW water leaves the cascade heaters, it passes through a blender that adds unheated HTW return to controls with setpoint that maintains the constant HTW supply temperature. Note that as distribution loads vary; less or more HTW water is required, and the HTW return temperature rises and falls depending upon the load. The existing system operates to control the HTW supply water, and does not take into account changes to load that would effect the overall heating requirements.

ECO 32

The total number of gallons lost in Building 25330 over the course of 1992 averages 43,663 gallons per month except for September where the very high recorded leakage is suspect. This leakage is caused by pipe failures and operating inefficiencies in the system. The quantity of lost water is based on reports of water meter readings made by the boiler operators.

ECO 68

Existing boilers are gas-fired with oil back-up. The steam generators are operating as intended. Efficiency testing that was reported by Gee Jenson shows the boilers in Building 25330 operate at approximately 75% efficiency at 100% - 25% capacity.

ECO 70

Space heating is not required from mid-May through the end of September, but a boiler must be in operation to handle domestic water needs and cooking requirements in some cases with the HTW distribution system.

ECO 72

There are steam leaks at steam valves and one hole was found in the cascade heaters. There are less leaks in this building than in Building 29510.

ECO 89

Existing automatic or manual controls are within the plant only with no EMCS tie-in for control. The EMCS office which is manned 24 hours a day has very few, if any instrumentation readouts from the plant, and no control of the plant with the EMCS. Because EMCS personnel are aware of what is happening in many buildings, they are also aware of conditions and demands on the high temperature water system. Currently, the boiler operators are making boiler pressure changes, HTW changes, bringing on and off boilers, and many manual valving operations. However, they are not performing the functions that an EMCS office can to control the energy consumed and to improve the operating efficiency of the Plant. The controls in Building 25330 have recently been upgraded and additions for EMCS points and new points are more readily available than in other places. Therefore, the amount of points necessary to be added is minimal. There is a computer existing that can currently read out large quantities of information.

03F !IMPACT IF NOT PROVIDED

***If this project is not implemented, Fort Gordon will continue to waste excessive quantities of energy. Use of antiquated, inefficient and potentially hazardous boilers will continue to require full staffing of boiler rooms and preclude the possibility of inefficient high temperature hot water system requiring minimum staffing. The lock of instrumentation on the current system assures energy waste and ultimately high maintenance costs.

Annual discounted savings has been determined to be $6,574,981 with a simple payback of 6.6 years with a savings to investment (SIR) of 2.81.

Heating loads will be unevenly distributed and buildings currently not being provided adequately heating will continue to be cold in the winter.

03G !ADDITIONAL

***New construction and renovation projects on the base will increase demand on the boiler plant to respond to new loading conditions.

03I !RELATED PROJECTS

***ECIP - 45553 - Chilled Water System to Central Utility Plant - Building 25330 North Side

ECIP - 45554 - Chilled Water System to Central Utility Plant - Building 25330 South Side

ECIP - 45555 - High Temperature Water Systems North Plant - Building 25910
/*

07A !GENERAL JUSTIFICATION DATA

This ECIP project is required to support the army wide effort to reduce energy waste. The project will provide new efficient high temperature hot water boilers and variable speed pumps to reduce energy consumption and increase efficiency. New instrumentation will permit better control and provide a means to reduce staffing requirements.

This ECIP consists of six ECO's identified during an energy study that constitute a cost justifiable solution to deficiencies in the current operation. The following justification overview lists the ECO's along with their economic justification.

PROJECT NO. 4 - HOT WATER SOUTH

ECO DATA COMPILATION

ECO NO.	DESCRIPTION	CONSTRUCTION COST	ANNUAL RECURRING COST	NON-RECURRING COST (-) SAVINGS (+)	TOTAL COST (From LCC)	ELECTRICAL SAVINGS MMBTU/YR	NAT GAS SAVINGS MMBTU/YR	SAVINGS 1st YEAR	TOTAL DISCOUNT SAVINGS
26	Variable Speed Pumping	23,980.00	0	0	26,738	379	0	5,771	90,086
28	Return Hot Water Temperature Control	48,573.00	600	0	54,160	0	3,045.32	14,304	296,079
32	Reduce Make-up Water	45,927.00	961	0	51,209	0	2,975.50	14,351	294,814
68	Hot Water Generators	694,840.00	10,000	0	774,748	0	4,662.00	30,977	587,085
70c	Summer Shutdown (1/2 gas, 1/2 hp)	244,294.00	79,725	0	272,389	529	15,477.00	157,426	2,760,665
72	Reduce Steam Leaks	1,290.00	0	0	1,439	0	199.00	897	18,797
89	EMCS Controls/Instrumentation	46,754.82	0	0	52,133	0	2,796.98	12,586	263,811
	Totals	1,105,659.00	91,286	0	1,232,816	908	29,155.80	236,312	4,311,334

Simple Payback: $\frac{1,232,816}{236,312} = 5.22$ yrs.

SIR: $\frac{4,311,334}{1,163,554} = 3.50$

07B !TRAFFIC ANALYSIS

***There will be no changes to pedestrian or vehicular traffic as a result of implementing this ECIP.
/*

08B !PRESENT ACCOMMODATIONS AND DISPOSITION

***The physical plant building 25910 housing the boiler plant is adequate to accommodate the new boilers and other modifications once the old boilers are removed. Five Steam boilers are being replaced with three high temperature hot water boilers.
/*

09D !RPMA DISCUSSION

***This ECIP will reduce the amount of Real Property maintenance activity because new high efficiency boilers and a new variable speed driver will be installed. Pipes, valves, strainers, heat exchangers and deaeration vessels will be replaced with new equipment.
/*

10A !ANALYSIS OF DEFICIENCIES

***1) High temperature water is pumped from the boiler plant with one of two available pumps. One of the pumps runs on slow speed to meet site requirements. All buildings serviced with HTW have two way valves in the HTW lines. When the buildings do not require heat, they close and HTW bypasses that building. As more buildings close, the valves pressure builds in the HTW supply line. This design wastes energy when demand for HTW is low.
2) High temperature water is supplied at a constant temperature, even when HTW demand is low. This wastes energy because the water temperature remains higher than required to meet site requirements.
3) Make up water requirements are high. A better means of detecting and locating sources of water leaks and excessive use is required.
4) The existing steam boilers operate inefficiently. The entire hot water generating system including piping, valves and expansion/storage tanks are inefficiently designed. The system locks the necessary instrumentation and controls to assist operators in running and maintaining the system efficiently. Boilers must be run all year to meet requirements for domestic hot water.
5) Steam leaks primarily around valves and cascade feedwater heaters cause energy waste.
/*

11D !DECISION ANALYSIS

***The following is a detailed cost breakdown of each of the ECO's. Refer to the table in 7A General Justification Data which summarizes these costs.

ECO 26 - LCCA

1.	Investment			
	A.	Construction Cost	$	23,980.00
	B.	SIOH	$	1,319.00
	C.	Design Cost	$	1,439.00
	D.	Total Cost (1A + 1B + 1C)	$	26,738.00
2.	Energy Savings		$	-5,615.00
3.	Non Energy Savings		$	0.00
4.	First Year Dollar Savings		$	5,771.00
5.	Simple Payback Period		$	4.63 Years
6.	Total Net Discounted Savings		$	90,086.00
7.	Savings to Investment Ratio		$	3.37

ECO 28 - LCCA

1.	Investment			
	A.	Construction Cost	$	48,573.00
	B.	SIOH	$	2,672.00
	C.	Design Cost	$	2,915.00
	D.	Total Cost (1A + 1B + 1C)	$	54,160.00
2.	Energy Savings		$	-2,949.00
3.	Non Energy Savings		$	8,844.00
4.	First Year Dollar Savings		$	14,304.00
5.	Simple Payback Period		$	3.79 Years
6.	Total Net Discounted Savings		$	296,079.00
7.	Savings to Investment Ratio		$	5.47

ECO 32 - LCCA

1.	Investment			
	A.	Construction Cost	$	45,927.00
	B.	SIOH	$	2,526.00
	C.	Design Cost	$	2,756.00
	D.	Total Cost (1A + 1B + 1C)	$	51,209.00
2.	Energy Savings		$	-3,019.00
3.	Non Energy Savings		$	14,164.00
4.	First Year Dollar Savings		$	14,351.00
5.	Simple Payback Period		$	3.57 Years
6.	Total Net Discounted Savings		$	294,814.00
7.	Savings to Investment Ratio		$	5.76

ECO 68 - LCCA

1.	Investment		
	A. Construction Cost	$	694,840.00
	B. SIOH	$	38,217.00
	C. Design Cost	$	41,691.00
	D. Total Cost (1A + 1B + 1C)	$	774,748.00
2.	Energy Savings	$	-1,332.00
3.	Non Energy Savings	$	147,400.00
4.	First Year Dollar Savings	$	30,977.00
5.	Simple Payback Period	$	25.01 Years
6.	Total Net Discounted Savings	$	587,085.00
7.	Savings to Investment Ratio	$	.76

ECO 70A - LCCA

1.	Investment		
	A. Construction Cost	$	330,296.00
	B. SIOH	$	18,167.00
	C. Design Cost	$	19,818.00
	D. Total Cost (1A + 1B + 1C)	$	368,281.00
2.	Energy Savings	$	10,540.00
3.	Non Energy Savings	$	1,175,147.00
4.	First Year Dollar Savings	$	165,479.00
5.	Simple Payback Period	$	2.23 Years
6.	Total Net Discounted Savings	$	2,886,362.00
7.	Savings to Investment Ratio	$	7.84

ECO 70B - LCCA

1.	Investment		
	A. Construction Cost	$	158,193.00
	B. SIOH	$	8,701.00
	C. Design Cost	$	9,492.00
	D. Total Cost (1A + 1B + 1C)	$	176,386.00
2.	Energy Savings	$	9,483.00
3.	Non Energy Savings	$	1,175,147.00
4.	First Year Dollar Savings	$	149,371.00
5.	Simple Payback Period	$	1.18 Years
6.	Total Net Discounted Savings	$	2,634,918.00
7.	Savings to Investment Ratio	$	14.94

ECO 70C - LCCA

1.	Investment	
	A. Construction Cost	$ 244,294.00
	B. SIOH	$ 13,437.00
	C. Design Cost	$ 14,658.00
	D. Total Cost (1A + 1B + 1C)	$ 272,389.00
2.	Energy Savings	$ 10,012.00
3.	Non Energy Savings	$ 1,175,147.00
4.	First Year Dollar Savings	$ 157,426.00
5.	Simple Payback Period	$ 1.73 Years
6.	Total Net Discounted Savings	$ 2,760,665.00
7.	Savings to Investment Ratio	$ 10.14

ECO 72 - LCCA

1.	Investment	
	A. Construction Cost	$ 1,290.00
	B. SIOH	$ 71.00
	C. Design Cost	$ 78.00
	D. Total Cost (1A + 1B + 1C)	$ 1,439.00
2.	Energy Savings	$ -5,795.00
3.	Non Energy Savings	$ 0.00
4.	First Year Dollar Savings	$ 897.00
5.	Simple Payback Period	$ 1.60 Years
6.	Total Net Discounted Savings	$ 18,797.00
7.	Savings to Investment Ratio	$ 13.06

ECO 89 - LCCA

1.	Investment	
	A. Construction Cost	$ 46,755.00
	B. SIOH	$ 2,572.00
	C. Design Cost	$ 2,806.00
	D. Total Cost (1A + 1B + 1C)	$ 52,133.00
2.	Energy Savings	$ -3,197.00
3.	Non Energy Savings	$ 0.00
4.	First Year Dollar Savings	$ 12,586.00
5.	Simple Payback Period	$ 4.14 Years
6.	Total Net Discounted Savings	$ 263,811.00
7.	Savings to Investment Ratio	$ 5.06

11E !ECONOMIC ANALYSIS
***ECO 26

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Variable Speed Drive	1	LS	11,000	11,000	1,500	1,500	$12,500.00
Switches	1	LS	4,340	4,340	1,000	1,000	$5,340.00
					SUBTOTAL		$19,032.00
					20% OH (GC ONLY)		$3,806.00
					SUBTOTAL GC'S WORK		$22,838.40
					SUBTOTAL (GC & SUBS)		$22,838.40
					5% CONTINGENCY		$1,141.92
					TOTAL		$23,980.32

ECO 28

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Controls	1	LS	20,000	20,000	15,000	15,000	$35,000.00
					SUBTOTAL		$38,550.00
					20% OH (GC ONLY)		$7,710.00
					SUBTOTAL GC'S WORK		$46,260.00
					SUBTOTAL (GC & SUBS)		$46,260.00
					5% CONTINGENCY		$2,313.00
					TOTAL		$48,573.00

ECO 32

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Flow Meters	10	EA	1,500	15,000	1,000	10,000	$25,000.00
Temp RTD in Distr. Pipe	10	EA	300	3,000	500	5,000	$8,0000.00
					SUBTOTAL		$36,450.00
					20% OH (GC ONLY)		$7,290.00
					SUBTOTAL GC'S WORK		$43,740.00
					SUBTOTAL (GC & SUBS)		$43,740.00
					5% CONTINGENCY		$2,187.00
					TOTAL		$45,927.00

ECO 68

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Hot Water Generator	2	EA	175,000	350,000	LUMP SUM	65,000	$415,000.00
Repiping of Cascade Heater	1	LS	6,000	6,000	8,000	8,000	$14,000.00
Controls for Hot Water Gen.	1	LS	25,000	25,000	20,000	20,000	$45,000.00
Demolition	1	LS			15,000	15,000	$15,000.00
Chemical Feed Equipment	3	LS	2,500	7,500	500	1,500	$9,000.00
Nitrogen Storage & Piping	1	LS	8,000	8,000	6,000	6,000	$14,000.00
					SUBTOTAL		$551,460.00
					20% OH (GC ONLY)		$110,292.00
					SUBTOTAL GC'S WORK		$661,752.00
					SUBTOTAL (GC & SUBS)		$661,752.00
					5% CONTINGENCY		$33,087.60
					TOTAL		$694,839.60

ECO 70A

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
2-1/2 Ton Heat Pump (51 Bldg)	1	LS	102,000	102,000	13,000	13,000	$115,000.00
Piping & Pumps to Exist. Tank	1	LS	25,500	25,500	21,500	21,500	$47,000.00
FCU in Building	1	LS	40,000	40,000	25,000	25,000	$65,000.00
Electrical Work	1	LS	7,500	7,500	7,500	7,500	$15,000.00
					SUBTOTAL		$262,140.00
					20% OH (GC ONLY)		$52,428.00
					SUBTOTAL GC'S WORK		$314,568.00
					SUBTOTAL (GC & SUBS)		$314,568.00
					5% CONTINGENCY		$15,728.40
					TOTAL		$330,296.40

ECO 70B

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Gas Piping (51 Bldgs)	1	LS	16,000	16,000	32,000	32,000	$48,000.00
Combustion Air Vent. (51 B)	1	LS	2,600	2,600	5,000	5,000	$7,600.00
Gas Fired Water Heater (51B)	1	LS	11,000	11,000	7,000	7,000	$18,000.00
Piping to Exist. Storage Tank	1	LS	17,000	17,000	14,000	14,000	$31,000.00
Pumps (51 Buildings)	1	LS	5,000	5,000	3,000	3,000	$8,000.00
					SUBTOTAL		$125,550.00
					20% OH (GC ONLY)		$25,110.00
					SUBTOTAL GC'S WORK		$150,660.00
					SUBTOTAL (GC & SUBS)		$150,660.00
					5% CONTINGENCY		$7,533.00
					TOTAL		$158,193.00

ECO 72

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Repair Steam Leaks	35	HRS			25	875	$875.00
				SUBTOTAL 1			$875.00
				17% LABOR TAX			$148.75
				SUBTOTAL 2			$1,023.75
				20% GC OH & PROFIT			$204.75
				SUBTOTAL GC WORK			$1,228.50
				5% CONTINGENCY			$61.43
				TOTAL			$1,289.93

ECO 89

ITEM DESCRIPTION	QUANTITY QUAN	UNIT	MATERIAL UNIT COST	EXTENSION	LABOR UNIT COST	EXTENSION	TOTAL
Fuel Flow	1	LS	4,000	4,000	2,000	2,000	$6,000.00
Expansion Tank	1	LS	1,400	1,400	600	600	$2,000.00
HTW Piping	1	LS	2,300	2,300	2,700	2,700	$5,000.00
Make-up Water	1	LS	2,000	2,000	1,500	1,500	$3,500.00
Nitrogen	1	LS	1,000	1,000	1,500	1,500	$2,500.00
Valve Positions	1	LS	700	700	1,300	1,300	$2,000.00
BTU Computations	1	LS	500	500	2,000	2,000	$2,500.00
Chemical Feed	1	LS	900	900	900	900	$1,800.00
HW Generator Pumps Control	1	LS	2,000	2,000	1,000	1,000	$3,000.00
HW Gen. Combust. Efficiency	1	LS	600	600	600	600	$1,200.00
Gauges and Dials	1	LS	2,000	2,000	2,000	2,000	$4,000.00
				SUBTOTAL 1			$33,500.00
				5% SALES TAX			$870.00
				17% LABOR TAX			$2,737.00
				SUBTOTAL 2			$37,107.00
				20% GC OH & PROFIT			$7,421.40
				SUBTOTAL GC WORK			$4,528.40
				5% CONTINGENCY			$2,226.42
				TOTAL			$46,754.82

/*

12A !CRITERIA FOR PROPOSED CONSTRUCTION

***Construction will occur inside the confines of the existing Building 25910. No additions to the exterior shell is required. Inside renovation work will conform to existing guidelines of architectural design and building construction, specifically the AEI Design Guide (March 1987), the Corps of Engineers Guide Specifications CEGS 13947 thru 13949 for Power Plant and EMCS requirements.

13B !FURNISHINGS AND EQUIPMENT DISCUSSION

***This ECIP consists of the following renovations and additions
1) Replace 2 steam boilers with HTW boilers.
2) Add variable speed drive pumps.
3) Install new instrumentation to automate the plant.
/*

15A !ENVIRONMENTAL DOCUMENTATION

***There will be no environmental impact to the modification, renovations and upgrades to the central utility plant heating system. Boilers being replaced will be dismantled and new high efficiency boilers, pumps and heat. The addition of chemical treatment system will be handled in accordance with state and federal regulations.

15B1 !SUMMARY OF ENVIRONMENTAL CONSEQUENCES

***We have reviewed this project and determine that an environmental impact statement, pursuant to PL 91-190, is not required. We have assessed this project and determined that it will not contribute significantly to air and/or water pollution.
/*

16A1 !EVALUATION OF FLOOD HAZARDS

***The renovation is to an existing plant. No history of flooding has been recorded.
/*

19A !SUMMARY OF ENERGY REQUIREMENTS

***Current Electrical oil and gas services are adequate to support the required upgrades to the heating system for the Central Utility Plant, Building 25910. There will be no changes or increased requirements for additional services. The demand for utility service will be reduced as the changes are implemented. See the cost and savings analysis for details.

19B !SUMMARY OF UTILITY SUPPORT

***The existing electric utilities supplied to the central plant is adequate and will not require additional capacity to be added.

20B !HAZARDS TO HANDICAPPED PERSONS

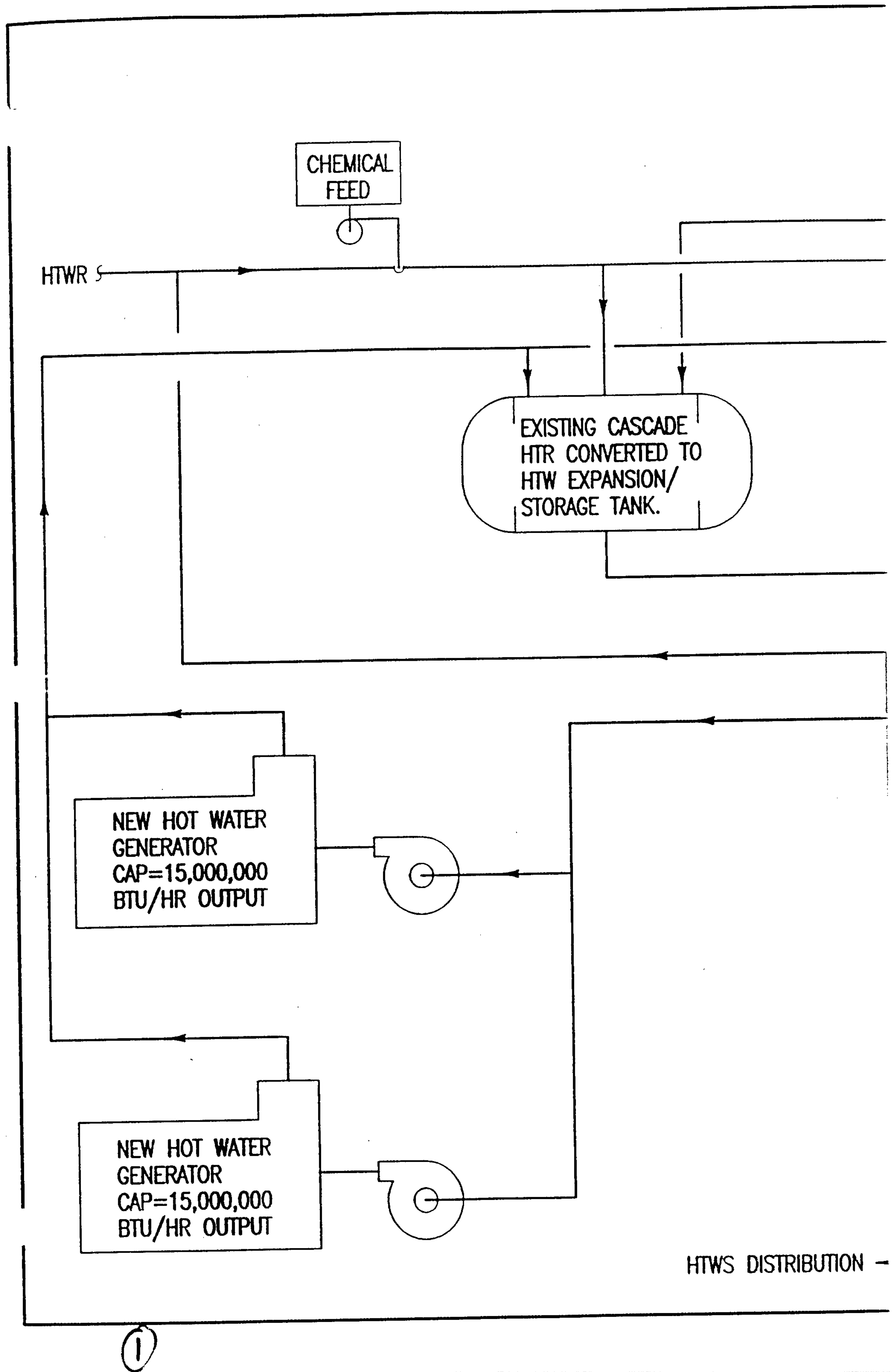
***Existing conditions within the physical plant is considered hazardous to unauthorized personnel. Signs and warnings are posted to alert unauthorized personnel access is restricted to authorized personnel and visitors with prior approval.

20C !HANDICAP PROVISIONS

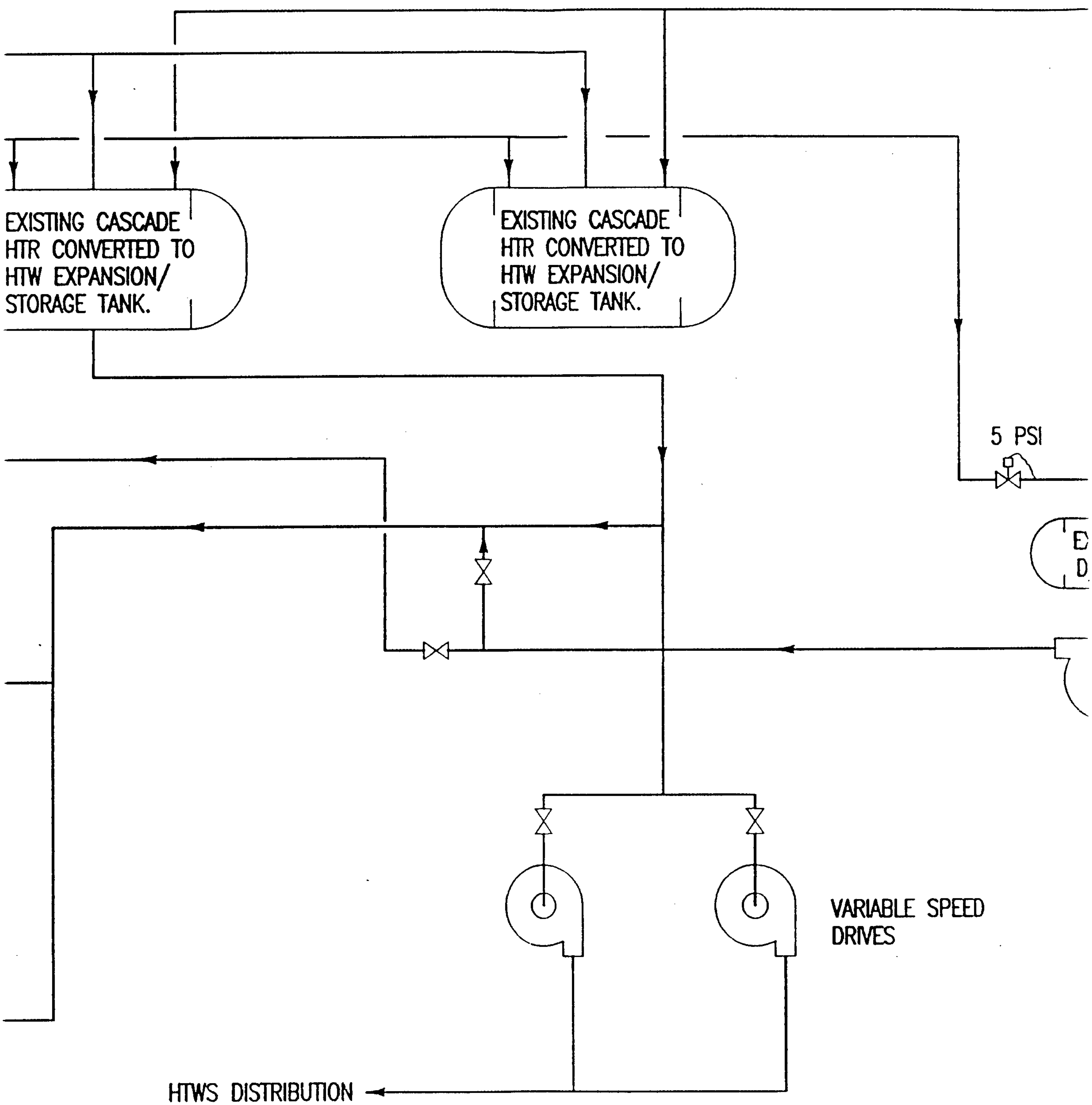
***In accordance with Public Law 90-480, no provisions for the handicapped will be made in the project since the facility is used and operated solely by able bodied personnel. However, the main floor of the facility is at ground level and is handicap accessible.
/*

22B !PHYSICAL SECURITY

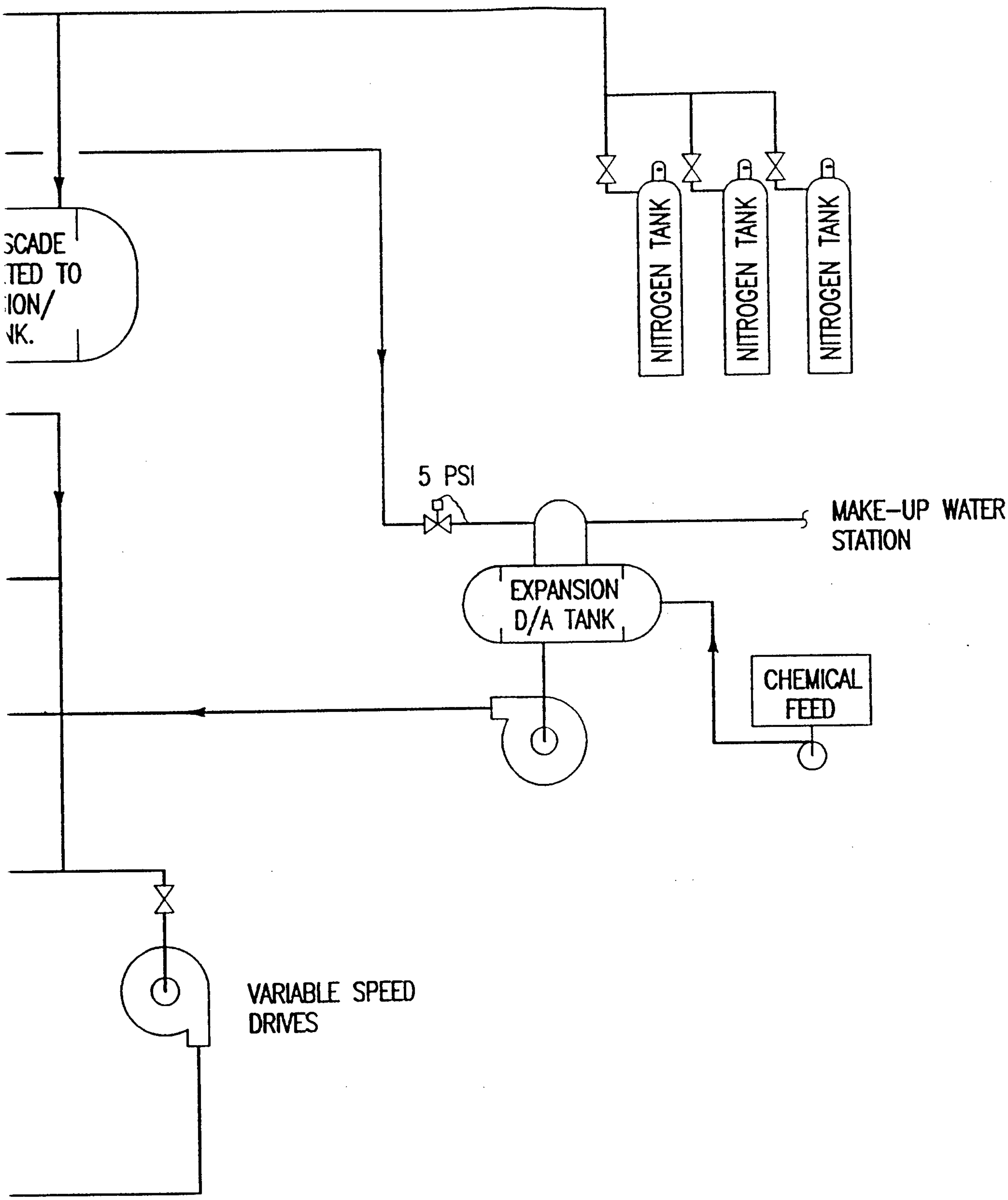
***Project is not considered for commercial activity. The physical plant upgrade to the existing Central Utility Plant will serve the north side of Ft. Gordon. Provisions of DA circular 235-1 are not applicable to this project.
/*


CHEMICAL FEED
HTWR
EXISTING CASCADE HTR CONVERTED TO HTW EXPANSION/ STORAGE TANK.
NEW HOT WATER GENERATOR CAP=15,000,000 BTU/HR OUTPUT
NEW HOT WATER GENERATOR CAP=15,000,000 BTU/HR OUTPUT
HTWS DISTRIBUTION
1

Project No. 4 – HTW Schemat



No. 4 - HTW Schematic-South Bldg. 25330



3

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO026
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 4 HTW SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: VARIABLE SPEED PUMPING
ANALYSIS DATE: 09-22-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT
A. CONSTRUCTION COST $ 23980.
B. SIOH $ 1319.
C. DESIGN COST $ 1439.
D. TOTAL COST (1A+1B+1C) $ 26738.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 26738.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	379.	$ 5771.	15.61	$ 90086.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	0.	$ 0.	20.96	$ 0.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5615.	$ 5771.		$ 90086.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 5771.

5. SIMPLE PAYBACK PERIOD (1G/4) 4.63 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 90086.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 3.37
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 9.56 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO028
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 4 HTW SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: CONTROLS
ANALYSIS DATE: 01-13-95 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 48573.		
B. SIOH	$ 2672.		
C. DESIGN COST	$ 2915.		
D. TOTAL COST (1A+1B+1C)	$ 54160.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 54160.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	3045.	$ 13704.	20.96	$ 287235.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-2949.	$ 13704.		$ 287235.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 600.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 8844.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 8844.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 14304.

5. SIMPLE PAYBACK PERIOD (1G/4) 3.79 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 296079.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 5.47
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 12.24 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: EC0032
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 4 HTW SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: REDUCE WATER
ANALYSIS DATE: 01-13-95 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT
A. CONSTRUCTION COST $ 45927.
B. SIOH $ 2526.
C. DESIGN COST $ 2756.
D. TOTAL COST (1A+1B+1C) $ 51209.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 51209.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	2976.	$ 13390.	20.96	$ 280649.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-3019.	$ 13390.		$ 280649.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 961.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 14164.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 14164.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 14351.

5. SIMPLE PAYBACK PERIOD (1G/4) 3.57 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 294814.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 5.76
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 12.53 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: EC0068
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 4 HTW SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: REPLACE BOILERS
ANALYSIS DATE: 02-21-95 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 694840.		
B. SIOH	$ 38217.		
C. DESIGN COST	$ 41691.		
D. TOTAL COST (1A+1B+1C)	$ 774748.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 774748.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	4662.	$ 20977.	20.96	$ 439685.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-1332.	$ 20977.		$ 439685.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 10000.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 147400.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 147400.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 30977.

5. SIMPLE PAYBACK PERIOD (1G/4) 25.01 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 587085.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .76
(IF < 1 PROJECT DOES NOT QUALIFY)

**** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: ECO070A

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 4 HTW SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: SUMMER SHUTDOWN-HEAT PUMPS
ANALYSIS DATE: 09-22-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 330296.		
B. SIOH	$ 18167.		
C. DESIGN COST	$ 19818.		
D. TOTAL COST (1A+1B+1C)	$ 368281.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 368281.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	1057.	$ 16111.	15.61	$ 251491.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	15476.	$ 69643.	20.96	$ 1459725.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		10540.	$ 85754.		$ 1711216.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) — $ 79725.
(1) DISCOUNT FACTOR (TABLE A) — 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) — $ 1175147.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 1175147.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 165479.

5. SIMPLE PAYBACK PERIOD (1G/4) 2.23 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 2886362.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 7.84
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 14.28 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO070B
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1:080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 4 HTW SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: SUMMER SHUTDOWN-GAS
ANALYSIS DATE: 09-22-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 158193.	
B. SIOH	$ 8701.	
C. DESIGN COST	$ 9492.	
D. TOTAL COST (1A+1B+1C)	$ 176386.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 176386.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	15477.	$ 69646.	20.96	$ 1459772.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		9483.	$ 69646.		$ 1459772.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 79725.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 1175147.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 1175147.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 149371.

5. SIMPLE PAYBACK PERIOD (1G/4) 1.18 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 2634918.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 14.94
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 18.02 %

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: ECO070C
LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 4 HTW SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: SUMMER SHUTDOWN-1/2 GAS 1/2HP
ANALYSIS DATE: 09-22-94 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 244294.			
B. SIOH	$ 13437.			
C. DESIGN COST	$ 14658.			
D. TOTAL COST (1A+1B+1C)	$ 272389.			
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$	0.	
F. PUBLIC UTILITY COMPANY REBATE		$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)				$ 272389.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	529.	$ 8056.	15.61	$ 125746.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	15477.	$ 69646.	20.96	$ 1459772.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		10012.	$ 77701.		$ 1585518.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 79725.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 1175147.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 1175147.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 157426.

5. SIMPLE PAYBACK PERIOD (1G/4) 1.73 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 2760665.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 10.14
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 15.76 %

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: ECO072
LCCID 1.080

INSTALLATION & LOCATION: FT. GORDON   REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 4   HTW SOUTH
FISCAL YEAR 1994   DISCRETE PORTION NAME: STEAM LEAKS
ANALYSIS DATE: 09-22-94   ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 1290.		
B. SIOH	$ 71.		
C. DESIGN COST	$ 78.		
D. TOTAL COST (1A+1B+1C)	$ 1439.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 1439.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	199.	$ 897.	20.96	$ 18797.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-5795.	$ 897.		$ 18797.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 897.

5. SIMPLE PAYBACK PERIOD (1G/4) 1.60 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 18797.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 13.06
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 17.24 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECO089
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 4 HTW SOUTH
FISCAL YEAR 1994 DISCRETE PORTION NAME: CONTROLS
ANALYSIS DATE: 02-19-95 ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT

A. CONSTRUCTION COST	$ 46755.		
B. SIOH	$ 2572.		
C. DESIGN COST	$ 2806.		
D. TOTAL COST (1A+1B+1C)	$ 52133.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 52133.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	2797.	$ 12586.	20.96	$ 263811.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-3197.	$ 12586.		$ 263811.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 12586.

5. SIMPLE PAYBACK PERIOD (1G/4) 4.14 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 263811.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 5.06
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 11.81 %

LIFE CYCLE COST ANALYSIS SUMMARY   STUDY: ECO089
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)   LCCID 1.080
INSTALLATION & LOCATION: FT. GORDON   REGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 4   HTW SOUTH
FISCAL YEAR 1994   DISCRETE PORTION NAME: EMCS-HTW SOUTH
ANALYSIS DATE: 01-13-95   ECONOMIC LIFE 20 YEARS PREPARED BY: HARVEY TOUB

1. INVESTMENT
A. CONSTRUCTION COST $ 46755.
B. SIOH $ 2572.
C. DESIGN COST $ 2806.
D. TOTAL COST (1A+1B+1C) $ 52133.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 52133.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 15.24	0.	$ 0.	15.61	$ 0.
B. DIST	$ 8.82	0.	$ 0.	17.56	$ 0.
C. RESID	$ 2.73	0.	$ 0.	19.97	$ 0.
D. NAT G	$ 4.50	2797.	$ 12586.	20.96	$ 263811.
E. COAL	$ 1.61	0.	$ 0.	17.58	$ 0.
F. LPG	$ 6.34	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 0.	14.74	$ 0.
N. TOTAL		-3197.	$ 12586.		$ 263811.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A)   14.74
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 12586.

5. SIMPLE PAYBACK PERIOD (1G/4)   4.14 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 263811.

7. SAVINGS TO INVESTMENT RATIO   (SIR)=(6 / 1G)=   5.06
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):   11.81 %